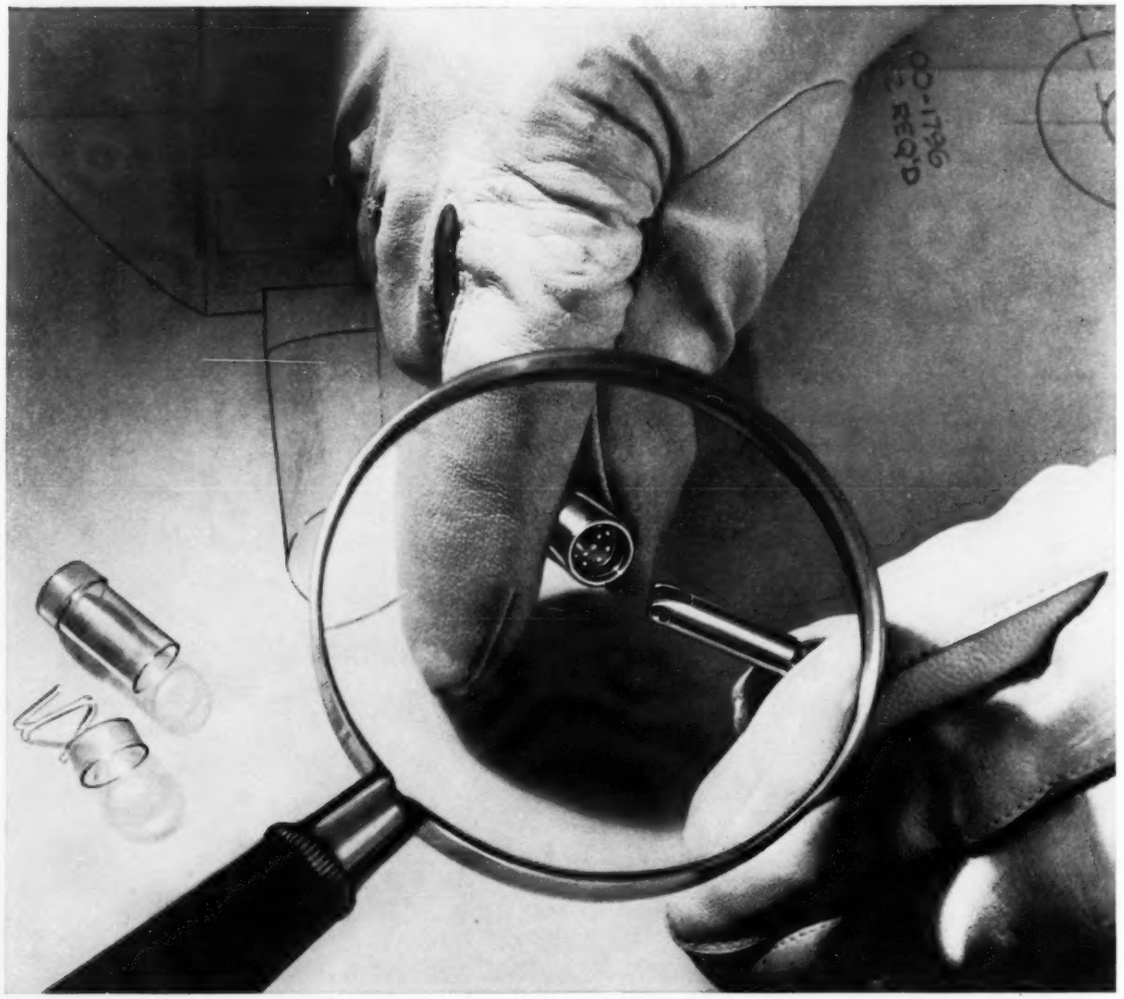
Design News

Miniature vane pump simplifies power-package design. Page 8.

A CAHNERS PUBLICATION

SEPTEMBER 1, 1961

NEW DEPARTURES IN MINIATURE



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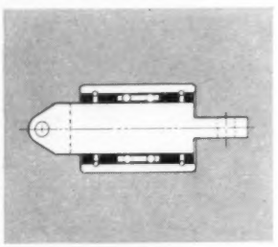
UNIQUE N/D LINEAR MOTION BEARING FREES GYRO CAGING ACTION

The bearing illustrated is an N/D linear motion precision instrument ball bearing. It was specially designed and built to help solve a critical problem in the guidance system of a high speed anti-submarine torpedo.

PROBLEM: Loss of accuracy in torpedo's guidance system due to hang-up of caging arm in gyro assembly.

SOLUTION: N/D Sales Engineer, in cooperation with manufacturer, found that *wear* of bushing on caging arm caused hang-up, delaying guidance activation. N/D Engineers set to work to design and build an instrument bearing that operates virtually friction-free. The result: Preservation of the guidance system's pin-point accuracy and reliability.

Should you require ball bearing design information, invite the local N/D Sales Engineer to participate in your early design discussions. He represents one of the industry's largest engineering staffs devoted exclusively to the design and development of miniature and instrument ball bearings. Or, write for new Miniature and Instrument Ball Bearing Catalog, Department L.S., New Departure, Division of General Motors Corporation, Bristol, Connecticut.



This special N/D linear motion instrument ball bearing increased guidance reliability of ASTOR torpedo weapon system developed by Westinghouse.

NEW DEPARTURE
MINIATURE AND INSTRUMENT BALL BEARINGS

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Design News

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ADVERTISEMENTS

1	2	3	4	5	151	152	153	154	155
6	7	8	9	10	156	157	158	159	160
11	12	13	14	15	161	162	163	164	165
16	17	18	19	20	166	167	168	169	170
21	22	23	24	25	171	172	173	174	175
26	27	28	29	30	176	177	178	179	180
31	32	33	34	35	181	182	183	184	185
36	37	38	39	40	186	187	188	189	190
41	42	43	44	45	191	192	193	194	195
46	47	48	49	50	196	197	198	199	200
51	52	53	54	55	201	202	203	204	205
56	57	58	59	60	206	207	208	209	210
61	62	63	64	65	211	212	213	214	215
66	67	68	69	70	216	217	218	219	220
71	72	73	74	75	221	222	223	224	225
76	77	78	79	80	226	227	228	229	230
81	82	83	84	85	231	232	233	234	235
86	87	88	89	90	236	237	238	239	240
91	92	93	94	95	241	242	243	244	245
96	97	98	99	100	246	247	248	249	250
101	102	103	104	105	251	252	253	254	255
106	107	108	109	110	256	157	258	259	260
111	112	113	114	115	261	262	263	264	265
116	117	118	119	120	266	267	268	269	270
121	122	123	124	125	271	272	273	274	275
126	127	128	129	130	276	277	278	279	280
131	132	133	134	135	281	282	283	284	285
136	137	138	139	140	286	287	288	289	290
141	142	143	144	145	291	292	293	294	235
146	147	148	149	150	296	297	298	299	300

NEW PRODUCTS

301	302	303	304	305
306	307	308	309	310
311	312	313	314	315
316	317	318	319	320
321	322	323	324	325
326	327	328	329	330
331	332	333	334	335
336	337	338	339	340
341	342	343	344	345
346	347	348	349	350
351	352	353	354	355
356	357	358	359	360
361	362	363	364	365
366	367	368	369	370
371	372	373	374	375
376	377	378	379	380
381	382	383	384	385
386	387	388	389	390
391	392	393	394	395
396	397	398	399	400
401	402	403	404	405
406	407	408	409	410
411	412	413	414	415
416	417	418	419	420
421	422	423	424	425
426	427	428	429	430
431	432	433	434	435
436	437	438	439	440
441	442	443	444	445
446	447	448	449	450

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Design News, Sept. 1, 1961
This Card Good Until
Nov. 6, 1961

LITERATURE

451	452	453	454	455
456	457	458	459	460
461	462	463	464	465
466	467	468	469	470
471	472	473	474	475
476	477	478	479	480
481	482	483	484	485
486	487	488	489	490
491	492	493	494	495
496	497	498	499	500
501	502	503	504	505
506	507	508	509	510
511	512	513	514	515
516	517	518	519	520
521	522	523	524	525

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_____

_____

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FREE REPRINTS

526	527	528	529	530
531	532	533	534	535
536	537	538	539	540
541	542	543	544	545

OTHERS

546	547	548	549	550
551	552	553	554	555
556	557	558	559	560
561	562	563	564	565

MAIL THE CARD TODAY

Design News

Sept. 1, 1961 Vol. 16 No. 18

4 **Special Report**
- 4 O-Ring Squeeze for Dynamic Sealing

8 **Design Ideas . . . Mechanical**
- 8 Novel Subminiature Pump Retains Advantages of Cartridge Construction (Cover)
- 10 Equalizing Hydraulic Rams Lift Saturn Tower on Trucks
- 12 Spring-Driven Escape Wheel Speeds Card Positioning
- 14 Assembly Machine Breaks, Reassembles Heat-Treated Connecting Rods
- 16 Movement of Optical Prism Indicates Thermal Expansion

20 **Design Ideas . . . Electrical**
- 20 Varistors Reduce Peak Voltage, Improve Magnet Circuit Performance

22 **New Products**
- 22 Mechanical 26 Electrical 28 Materials 30 Equipment

32 **Design Ideas . . . Materials**
- 32 Brazed Aluminum Mounting Frame Holds Transponder in Nose Cone
- 34 Plastic Foam Drum Cycles Parts for Thermal Shock Tests

36 **Design Data**
- 36 Gearing Nomenclature
- 41 International Standard Prefixes

46 **Design Ideas . . . Controls**
- 46 All-Hydraulic Crane Features Two-Speed Stepless Hoist Control
- 48 Mechanical Memory Board Simplifies Design and Operation of Typesetting System

Novel Subminiature Pump Retains Advantages of Cartridge Construction . . . Page 8

2 Sounding Board
3 Design Views
6 Seen and Heard
18 Patents
42 New Literature
44 Technical Papers
58 Index of Advertisers
59 Product Index
60 Plans and Cross Sections

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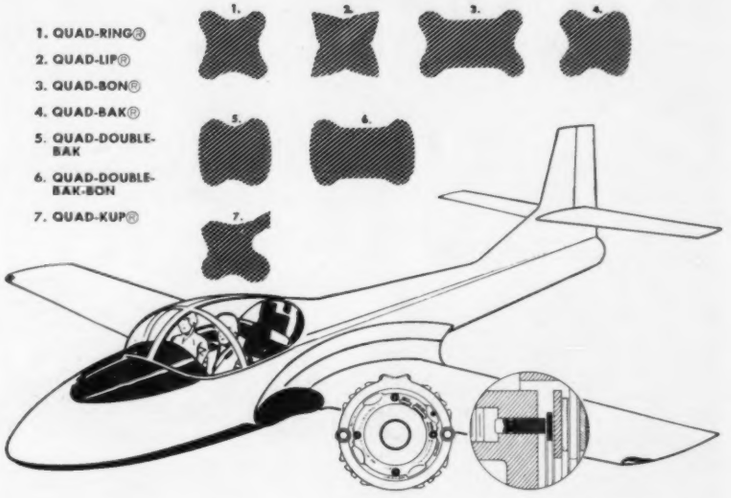
MINNESOTA MR RUBBER

SPECIAL QUAD-RING® DESIGNS



Quad-Bak—used as a power-transmitting dynamic seal installed on the Auto Specialties Manufacturing Co. aircraft brake.

QUAD-RING® BASIS FOR THE DESIGN OF A WHOLE FAMILY OF VERSATILE SEALS

QUAD-RING—An exclusive development of Minnesota Rubber to give outstanding service in a wide range of dynamic and static sealing applications.

QUAD-LIP—Developed for applications which require zero leakage at very low pressure differentials with minimum mechanical interference.

QUAD-BON—Provides maximum resistance to spiraling in the smallest space possible while maintaining the sealing characteristics of the basic QUAD-RING.

QUAD-BAK—Designed to eliminate damage to packing when subjected to extreme extrusion in one direction only.

QUAD-DOUBLE-BAK—A double acting packing for maximum resistance to extrusion while maintaining two effective sealing lips.

QUAD-DOUBLE-BAK-BON—Provides maximum resistance to both spiraling and extrusion in a double acting installation.

QUAD-KUP—A unidirectional seal used where low friction is desirable but tolerances require a relatively large rubber-to-metal interference to take up for runout.

These special cross sections of the basic QUAD-RING design are just a few of the modifications possible to give complete versatility for any sealing application.

Manufactured under U.S. patents RE 24332 and 2,873,132, other patents pending.

FOR MORE INFORMATION ON QUAD-RINGS AND A COPY OF THE MINNESOTA RUBBER FACT BOOK . . .

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SOUNDING BOARD

FOR OUR READERS

Missile Tracker Mount

May I express my gratitude and thanks for the excellent article and cover picture of the PIM Instrument Mount which you published on July 21. Your article stated the novel principles of design so clearly and concisely that engineers working in this important field can proceed one step further in the state-of-the-art. In one respect, however, I would appreciate a footnote to the story.

The PIM Instrument Mount was developed under contract with the U. S. Army Signal Corps Research & Development Laboratories, and we at AMF would like to share our credit for its development with the U. S. Signal Corps.

K. E. SCHONERT
Radar Equipment Projects Office
American Machine & Foundry

Miniature Batteries

We are engaged in miniaturizing a square-wave pulse oscillator to be used in animal research. This unit requires from between 22 to 30v d-c at a current drain of 9 ma. During normal operation the unit will run about 15 minutes per day. . . . We are interested in purchasing batteries of lead, nickel or zinc composition that will give the above-stated power requirement. It is preferred that the weight not exceed 20g, and the battery should be as small and light as possible. Could you provide us with information as to who is producing such a unit?

FREDERICK A. KING, Ph.D.
Asst. Res. Professor of Neurosurgery
The J. Hillis Miller Health Ctr.
University of Florida
Gainesville, Fla.

• **Can any of our readers help Dr. King?**

Metric System

Re: Metric System, Sounding Board, June 5 issue of DESIGN NEWS.

I wonder if R. H. Mehl or James Roosevelt knows that the Metric System was legalized by the U. S. Congress in the year 1866, almost 100 years ago.

LEWIS W. MCCLELLAN
Aerojet General Corp.
Sacramento, Calif.

Patent Protection

The item on page 18 of your January 16, 1961 issue of DESIGN NEWS is fully protected by Italian patent No. 594262. The fact was not mentioned in the article.

COSTRUZIONI MECCANICH BROSI SAS
Turin, Italy

Decline and Fall

May I answer your question commenting on the remarks on "Decline and Fall" (August 4, 1961) with another question—What choice do we have?

ROMAN WINOGRAD
Consulting Mechanical Engineer
8 Harding Pkwy.
Mount Vernon, N. Y.

I have just read with great interest and complete agreement your excellent editorial, "Decline and Fall," in the June 19 issue of DESIGN NEWS.

I request permission to have this article reprinted, with credit, by our Employee and Plant Community Relations Section for distribution to our employees.

W. D. BECKER
Supervisor-Drafting
Insulator Dept.
General Electric Co.
Baltimore 3, Md.

• **Permission granted.**

In your issue of DESIGN NEWS, June 19, you had an editorial under the title "Decline and Fall". In the issue of July 7, you published in the Sounding Board a letter: "Credits". Maybe there is some connection between these two articles.

The editorial says ". . . these are symptoms of moral decay. . ." But it is not only this sickness. We are suffering too from a lack of understanding of intelligence, of the work of intelligent people, of honesty to give credit to persons who earn the credit.

The whole academic professions suffer under this lack of understanding. And it is a bad sign that this lack is nourished by people or groups who make out of this a profit. This is a demoralizing activity in its highest gear.

DR. ROBERT LOBSTEIN
Santa Monica, Calif.

Allow me to commend you on your editorial, "Decline and Fall", appearing in the June 19 DESIGN NEWS. Let us hope and, at the risk of sounding "stuffy", pray that your message and others like it will arouse enough people to action so that the answer to your last question will continue to be a resounding "no".

PAUL P. LEO
San Diego, Calif.

Silver Platter

In the May 22nd issue, I discussed briefly in this column some points pertaining to freedom of the press. A more recent editorial by Jack Koellisch, Editor of Wood & Wood Products, hits another angle of this security problem—the technical know-how angle. He describes how two West Coast manufacturers turned down a lucrative order for a completely automated sawmill to be built in this country and shipped to Russia. These companies turned down the order solely on the basis that they did not want to close the knowledge gap and thus hand an advantage to the Russians on a silver platter.

There was a time when Russia was paying American technical personnel fantastic salaries to help train and educate their people. The picture has changed considerably since those days. Now knowledge is gained by purchase of equipment rather than purchase of personnel.

The record books are replete with examples of this sort of plagiarism on the part of the Russians. Their tractors, for instance, are almost direct copies of Caterpillar tractors purchased originally from this country. Certainly there have been design changes in this equipment, primarily to solve production problems. But the basic design remains and has saved the Russians years of development work.

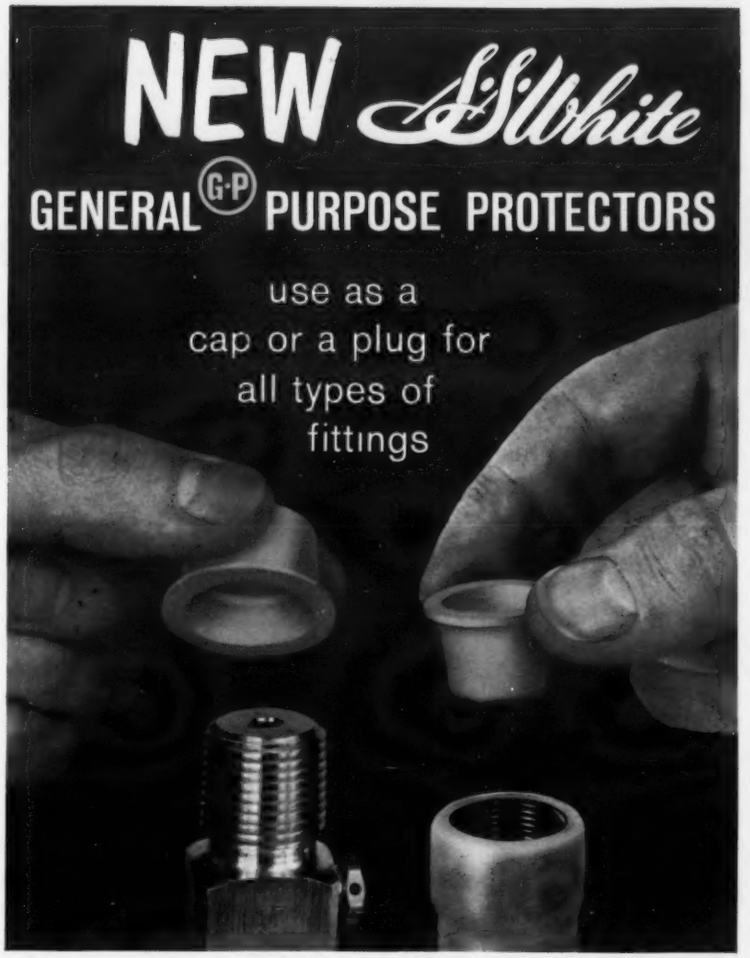
It takes a lot of courage to turn down a profitable order solely on the basis of patriotism. The companies involved realize that sooner or later the Russians will build their automated lumber plant. By refusing the order they are forcing the Russians to do their own development work, perhaps using people that otherwise would be needed elsewhere.

This is not the only answer to maintaining a suitable gap between the two opposing industries. Withholding know-how is not necessarily a positive approach to the problem. The positive approach is to think in terms of improving our own know-how faster.

On the other hand, there is no point in closing the gap intentionally by handing know-how to them on a silver platter. It seems wise to let them work out their own problems.

J. C. Dubois

Executive Editor



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DESIGN SPECIAL REPORT NEWS

O-Ring Squeeze for Dynamic Sealing

Factors Affecting O-Ring Seal for Reciprocating Motion

Edward W. Schrader, Western Editor

In dynamic sealing with O-rings, the designer has only two major variables where he may use discretion. These are: choice of material and amount of squeeze. Rotary motion is excluded from this discussion, since special problems pertain to the rotary seal that have no place in designing for reciprocating motion.

Material selection is usually straightforward, especially with so many stock types and sizes available. The designer must choose his material primarily for fluid compatibility and for extremes—either high or low—in temperature; specifically, the designer must choose the compound with the physical characteristics he desires. He must not exceed these limits when the seal is placed in the groove.

Once the material is selected, the designer has only the physical dimensions left to his opinion and debate. And debate there is. Both the experienced and inexperienced designer like to express their views when it comes to choosing the physical dimensions, or the O-ring squeeze, for a reciprocating seal.

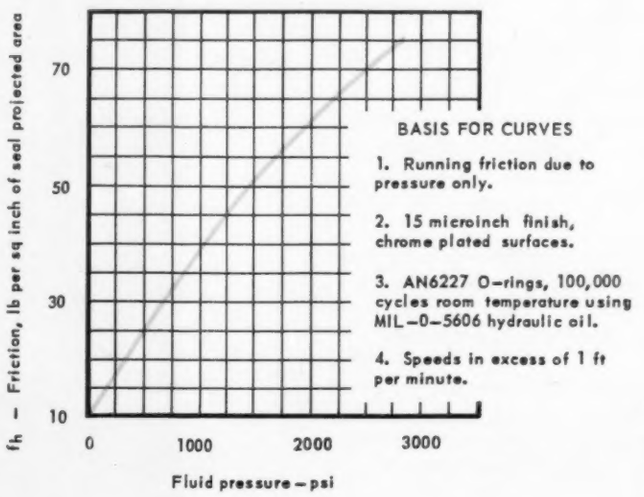
An O-ring seal operates by distortion of the seal material to create zero clearance. The dimensions of the gland establish this distortion.

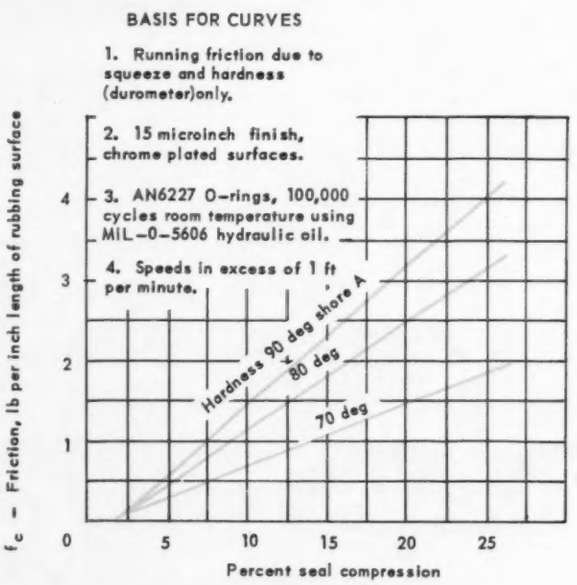
The O-ring is a popular seal because of its simple shape—a torus. It is relatively inexpensive to manufacture and it is simple to install. Its greatest asset is its ability to absorb tolerances and deviations inherent in machined parts. It will compensate for dimension changes resulting from temperature, pressure and wear.

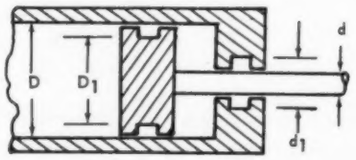
Some understanding of the torus seal can be gained if the designer will think of the rubber, or elastomer, as a highly viscous fluid. As such, imposed three-dimensional volume changes are absorbed in two-dimensional movement.

This property occurs when the O-ring is used as a reciprocating seal. For temperature change, the volume changes in two dimensions because the seal is confined. The same characteristic occurs when a fluid causes the ring to swell. Thus, it may be observed that with a confined periphery on the O-ring, the groove is all important for sealing.

Some fundamental points to remember about re-


f_h = Friction, lb per sq inch of seal projected area
70
50
30
10
0
1000
2000
3000
Fluid pressure – psi
BASIS FOR CURVES
1. Running friction due to pressure only.
2. 15 microinch finish, chrome plated surfaces.
3. AN6227 O-rings, 100,000 cycles room temperature using MIL-O-5606 hydraulic oil.
4. Speeds in excess of 1 ft per minute.





PISTON GROOVE	ROD GROOVE
$F_c = (f_c)\ (L_p)$	$F_c = (f_c)\ (L_r)$
$F_h = (f_h)\ (A_p)$	$F = (f_h)\ (A_r)$
$F = (F_c)\ (F_h)$	$F = (F_c)\ (F_h)$

$A_p = \frac{\pi}{4}\ (D^2\ \text{max} - (D_1)^2\ \text{min})$ = Projected area of seal for piston groove applications

$A_r = \frac{\pi}{4}\ ((d_1)^2\ \text{max} - d^2\ \text{min})$ = Projected area of seal for rod groove applications

F = Total seal friction in pounds

F_c = Total friction due to seal compression

F_h = Total friction due to hydraulic pressure on seal

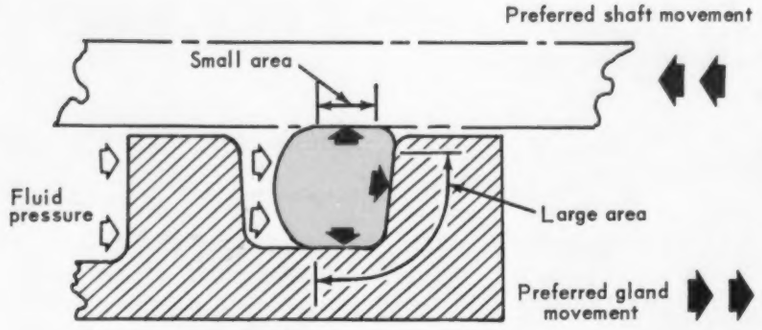
f_c = Friction due to O-ring squeeze or compression

f_h = Friction due to fluid pressure on seal

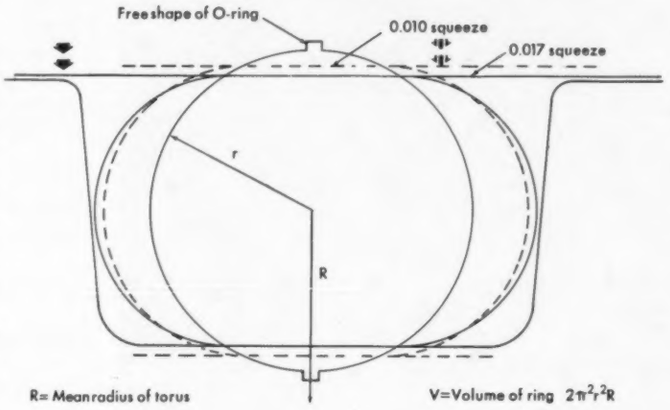
$L_p = \pi\ d\ \text{max}$ = Length of seal rubbing surface in inches for piston groove applications

$L_r = \pi\ d\ \text{max}$ = Length of seal rubbing surface in inches for rod groove applications

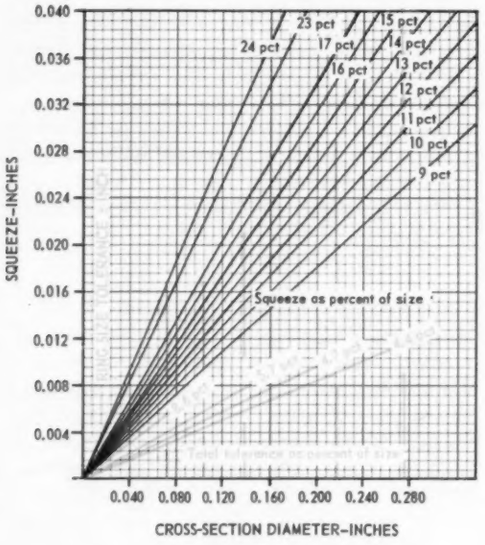
FRICTION caused by squeeze and rubber hardness can be estimated from curves by applying formula. Running friction results primarily from two factors: squeeze on O-ring cross-section and force caused by hydraulic pressure. These may be estimated by selecting proper value from each curve and inserting into appropriate formula shown. Break-out friction may be estimated as 3 to 10 times that for running friction. Break-out friction increases with time between actuation.



O-RING deforms under fluid pressure and squeeze to effect seal. Fluid pressure acts to prevent rolling of O-ring. Place groove so friction force of moving metal surface against O-ring opposes fluid pressure, otherwise O-ring will tend to be dragged into clearance gap more readily and thus extrude at a much lower (30 to 40 percent) than normal pressure. Snubbing cylinders in which motion and force create pressure are worst trouble makers.

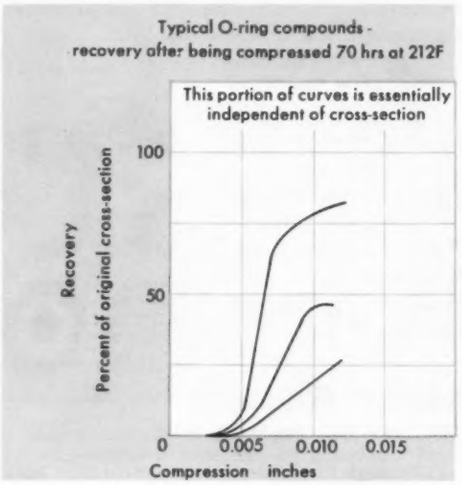


GROOVE DEPTH varies with amount of squeeze. Sides of torus flatten where rubber contacts metal. With squeeze, ends of cross-section retain circular shape as ring expands to fill groove. Mean diameter of torus (2 x R) should be chosen so that it is at midpoint of groove for radial seals. O-ring surface opposite pressure should be coincident with end of groove for axial seals. Place rubber in compression, not in tension, whenever possible. Recommendations vary on minimum surface finish for groove walls from 125 to 32 microinches rms. Finish up to 16 microinches rms is preferred by some designers, especially for low-temperature service. No sliding surface finish should be finer than 5 microinches rms.



O-RING SQUEEZE is described in either percent or thousandths of an inch. Definition of squeeze by percentage is measurement of strain, inches deflection per inches original dimension, converted to percent. When discussing squeeze, care must be used also to specify which cross-section applies. To seal, O-ring must have some minimum squeeze to accommodate manufacturing tolerances, then additional squeeze is used to seal under temperature change and machining tolerances. Percent squeeze must be greater for small cross-section sizes than for large sizes.

GRAPH illustrates that minimum useful squeeze is 0.005 inch, regardless of cross-section size, for "Buna-N" compounds. Fluid leakage is almost certain to occur if squeeze is less than 0.005 inch after all tolerances and eccentricities are absorbed. O-ring manufacturers report that 95 percent of reciprocating seal failures and troubles result from too little squeeze. If friction force is critical, some other shape elastomer seal should be used.



ciprocating seals:

The higher the temperature (above 100F), the greater the tendency of the light ends of the oil to evaporate from an exposed surface. The resulting lack of lubrication will greatly accelerate wear. At higher temperatures, the tacky residue which remains after oil evaporation will char. This leaves a hard abrasive surface which causes additional wear.

Low temperatures are more troublesome. If the seal has taken a compression set at a high temperature and is then subjected to a low temperature, there may be insufficient resilience in the rubber to overcome its skrinkage at the low temperature. Once the seal is unseated from a given spot on a metal surface, the seal must be reseated by either resilience or pressure. It is much easier to maintain a seal in a hydraulic system if pressure remains on the seal as the temperature drops.

Low-pressure (less than 25 psi) fluids or gases are prone to leak if an O-ring is used as dynamic seal at —65F, even when a so-called 65F compound is used. Such a compound is more resilient above —45F. The extremely low temperature delays the response of the rubber especially in the near absence of fluid pressure. Therefore, the O-ring is not always tightly seated during, and immediately after, motion of the gland.

The best squeeze for a reciprocating O-ring seal must be a compromise of all the factors involved. Design tables published by O-ring manufacturers are generally satisfactory for most applications. These tables are conservative. The wider the temperature range to be sealed, the more squeeze that is needed. The same is true of low pressure or vacuum.

On the other hand, too much squeeze will cause excessive friction, wear and occasionally spiral failure. Some rubber compounds require more squeeze than others in order to seal. Of the compounds generally available, the "Buna-N"-base compounds are recommended whenever possible. They are more extrusion and wear resistant and require less squeeze to seal than other oil-resistant rubbers developed to date.

Squeeze is actually necessary only to initiate sealing. As pressure increases, the O-ring seeks the path of least resistance; the clearance gap tends to be sealed tighter and tighter as the pressure goes up.

Enough squeeze should always be provided to off-set the great difference in coefficients of shrinkage for rubber and to take up the tolerances of both the metal and the rubber parts. Shrinkage (if any) of the rubber in the fluid also must be considered.

Technical information for this article was provided by Stillman Rubber Co., Culver City, Calif. and Parker Seal Co., a division of Parker-Hannifin Corp., Culver City, Calif.

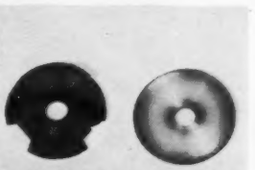
Wear like this led to replacement of 7 metal parts by ADIPRENE

Highly abrasive glass dust caused this reciprocating rod to cut entirely through a metal bearing and most of the cylinder rod end plug in a UNIFIL® loom-winder used in glass fabric weaving. An ADIPRENE bearing was still performing well a year later, after more than 200 million strokes.

ADIPRENE® still at work after 200,000,000 strokes...on a job too tough for metal bearing

Tiny glass particles ground gaping holes in vital metal parts on glass fabric weaving equipment. An obvious solution was substitution of non-metallic parts. But when conventional rubbers and plastics were tested, failure again occurred. ADIPRENE urethane rubber, however... with its excellent resistance to abrasion, plus its combination of hardness, resilience, and load bearing capacity... tested so successfully that now seven ADIPRENE parts are used in the same loom-winding machine. These parts reduce downtime and increase quality by making possible continuous runs of the glass fabric.

ADIPRENE can help you in the design of better, longer-lasting parts. It is oil-resistant, machinable and has outstanding electrical properties. For detailed information on the unusual combination of properties of ADIPRENE, write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department DN-9, Wilmington 98, Delaware.



Conventional rubbers were also tested for textile machinery parts. ADIPRENE far outlasted all metals, plastics and rubbers.

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SEEN AND HEARD

A Buick V-6 in '62?

E. J. Stefanides, Central States Editor

Sometime ago, flying from Pittsburgh to Detroit, I happened, quite by accident, to sit next to Joseph D. Turlay who heads up Buick's Engine Development Group. During the flight I asked him point blank about the rumors concerning a possible new V-6 engine from Buick this year. Some of these rumors are pretty reliable—one foundry equipment sales engineer said he saw the block and other castings sitting in the Central Foundries.

Joseph Turlay would not confirm or deny the rumors, in fact, he just didn't talk about it. However, he was willing to talk about testing a fleet of '62 cars on our famous Pittsburgh hills. He was really satisfied with their performance.

The Big Year For The V-6

Now on the eve of the showing of the new models it is practically a certainty that a V-6 will make its debut in this year's Buick. Although Buick has not officially released any confirming information for publication, there have been enough reliable reports in and around Detroit to indicate that this will be the year. The engine will probably be a liquid-cooled job somewhere in the 130- to 140-hp range. This size would, of course, make it a good bet for standard equipment on the smaller cars of the line with the aluminum V-8 being continued as an option.

A 90-Deg V-6?

Even more interesting design-wise is the report that it may be a 90-deg V-6. If true, this would make it the first 90-deg V-6 to be used on a major auto line either here or abroad.

Other New Engines

A number of other new engines will be appearing in the new model cars. These include several V-8 and four-cylinder jobs. Though these are not as unconventional in design as the V-6, they should make it an interesting year for the engine-conscious car buyer. One of these engines will be of particular interest to those of you who do your own re-

pairs. It's quite compact, leaves plenty of room under the hood for elbows when doing maintenance and should save a lot of knuckle-busting.

Aluminum Engines

It still appears to be an open question as to whether aluminum or cast iron will emerge as "the engine material" in Detroit.

There are reports that American Motors will use a die-cast aluminum head on the '62 Rambler over-head valve engine. Aluminum V-8 engines also will continue to be offered as optional on most of the GM line. A greater use of aluminum is also expected from Chrysler.

On the other hand, the new engines making their debut this year favor cast-iron construction.

The '63 models will probably shed more light on the matter, though at the present there is extensive development work being done on both sides of the fence—in some cases by the same manufacturer.

Other Trends

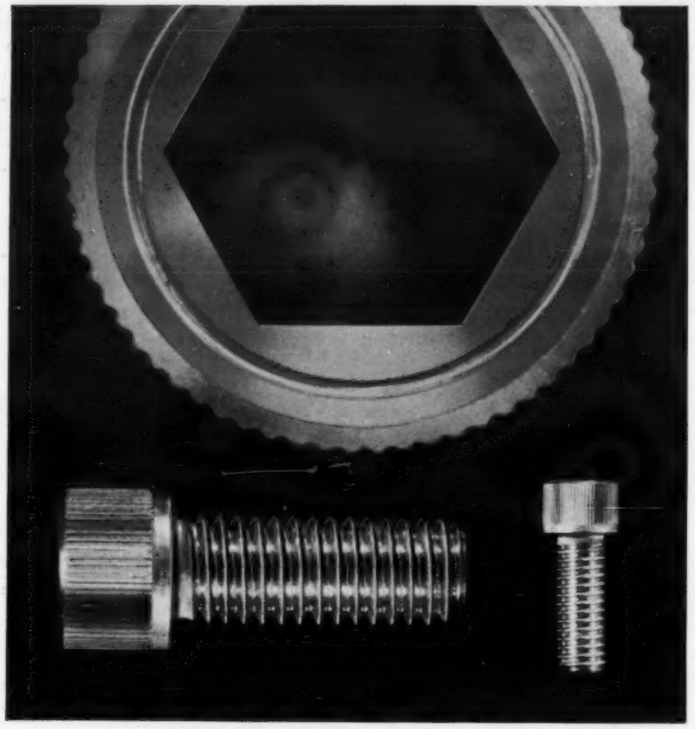
1962 will probably include a lot of in-between-sized cars. One automotive man calls it "personalized" transportation; a size and style for every garage (and purse?).

Single-leaf springs also are being reported to make their appearance this year in the new Chevrolets. These springs are single bars of spring steel which are varied in thickness and width along their length to achieve the desired spring characteristics. The new springs are said to offer a smoother, quieter ride.

In addition to these major changes, all the manufacturers have been refining the proven features of the '61 models. One thing along this line puzzles me. You hear a lot of talk about components being redesigned because of the number of failures during warranty. After a while you have the feeling that the criterion of a good component is whether or not it outlasts its warranty.

Is it possible that the manufacturers are going back to poetry for their inspiration and building cars in imitation of a wonderful one-horse shay, to collapse in a heap after a year and a day?

New UNBRAKO stainless socket screws offer 125,000 psi minimum tensile—certified!



Groove around socket identifies UNBRAKO KS 812 stainless tension fasteners, latest in new SPS high-performance K Series. Affidavit certifying 125,000 psi minimum tensile accompanies every lot.

TYPICAL MECHANICAL PROPERTIES
UNBRAKO KS 812 Stainless Socket Head Cap Screws

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Ultimate tensile strength, psi	147,000	131,870	101,400
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Shear strength, psi		85,000	
Fatigue endurance, psi		40,000	
Stress relaxation Initial stress 65,000 psi Residual stress after 50 hr			55,000
Magnetic permeability		below 1.05	

Besides high tensile strength, KS 812 offers good shear and endurance properties, adding to overall reliability of your stainless assemblies. New fastener meets or exceeds AMS 7472, FF-S-86.

If you are looking for more fastening strength in your stainless designs (without going to specials) . . . or for ways to reduce size or number of fasteners . . . the new UNBRAKO KS 812 provides an answer. Here at last is a stainless steel socket head cap screw offering a guaranteed tensile strength of 125,000 psi minimum. Yet this precision-forged, burr-free fastener is a standard, available in quantity off the shelf.

To make a corrosion-resistant cap screw that can be certified for 125,000 psi tensile, SPS uses a high-grade austenitic stainless, hardening it through cold working. Heads and sockets are forged; threads are rolled to preserve integrity of grain structure and enhance overall mechanical properties. Also the KS 812 has both the UNBRAKO pHd* head, which gives greater holding power, and the SPS Hi-Life thread root form, which increases fatigue resistance.

UNBRAKO KS 812 socket screws offer high corrosion resistance over a wide range of applications, as well as low magnetic permeability (under 1.2). Serviceable from —300° to 800°F, they come in sizes #8 through ⅜ in., fine or coarse thread. Ask your UNBRAKO distributor for more details or write Standard Pressed Steel Co. for new Bulletin 2734. INDUSTRIAL FASTENER Division, SPS, JENKINTOWN 6, PENNSYLVANIA.

*proper Head design (1960 series—standard on all UNBRAKO socket head cap screws, as is Hi-Life thread)

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Novel Subminiature Pump Retains Advantages of Cartridge Construction

E. J. Stefanides, Central States Editor

A new high-pressure, subminiature vane pump with high-speed, high-performance capabilities retains the advantages of cartridge construction despite a cartridge diameter of only 3/4 inch. The unit has a displacement range of 0.003 to 0.013 cu in/rev, permitting output of 0.28 to 1.46 gpm at speeds from 8000 to 26,000 rpm.

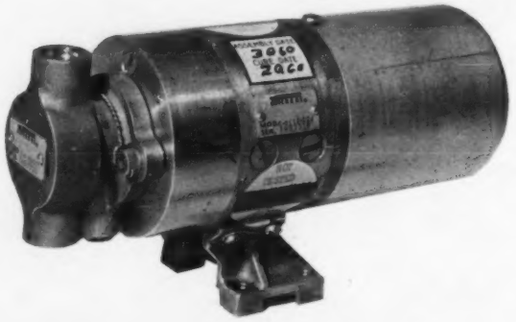
In miniaturization, scaled-down dimensions magnify critical design areas. This magnification also exaggerates the effect of manufacturing variations, and normal tolerances thus can affect seriously the performance of the pump In this design, precision manufacturing standards minimize the effects of these errors, improving overall performance, and in one instance actually providing a partial solution to a difficult design problem. All pumping parts are contained within a removable cartridge ring clamped between a fixed rear port plate and two concentric floating front pressure plates. During operation, hydraulic pressure on the front pressure plates provides the necessary axial force to maintain an effective seal at rotor and vane ends and to clamp the cartridge ring.

Hydraulic pressure also is used to supplement centrifugal force in maintaining an effective seal at the vane tips. Passages in the rotor connect the base of the vane to the high-pressure outlet port areas to provide an additional force on the vane to aid tracking on the inner surface of the cartridge ring.

The inner surface of the cartridge ring is contoured to provide two pumping chambers with inlet and outlets in opposing quadrants. This results in a radial balancing of all hydraulic forces so that there is no net load on the rotor bearing. This hydraulic balancing makes possible a reduction in bearing size, holding overall size and weight to a minimum and improving pump life and overall efficiency.

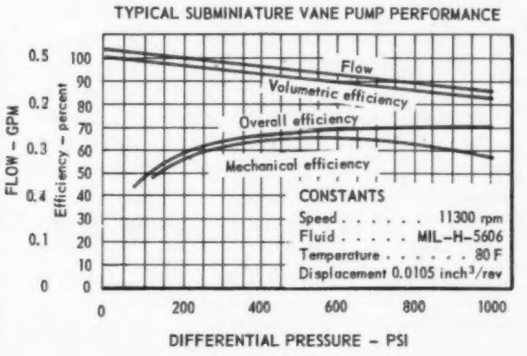
Other advantages accruing from the cartridge construction are simplicity of maintenance and adaptability of the design to a wide variety of application needs. The cartridges can be stacked on a common shaft in arrangements to provide multistaging for higher pressure applications or parallel-staging for high-output, lower pressure applications.

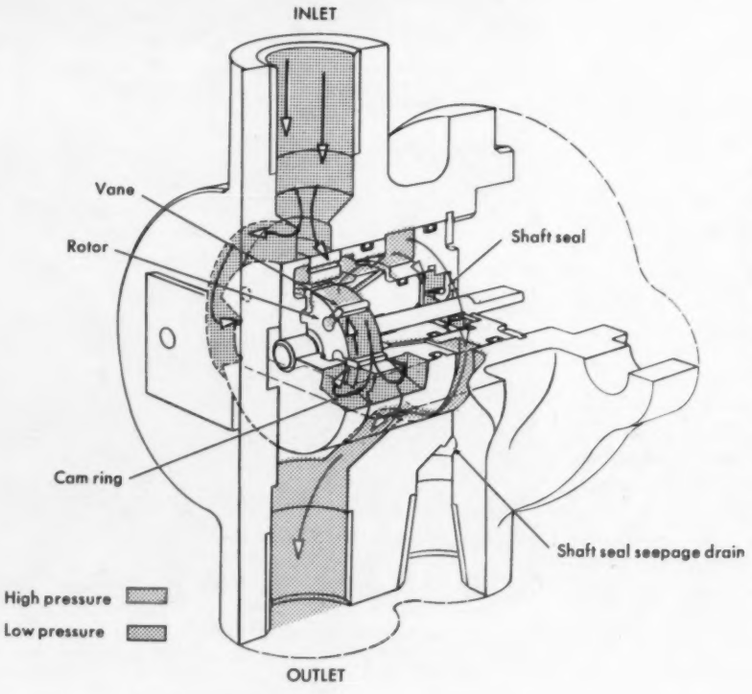
One of the most difficult problems in the design of the pump was providing a satisfactory shaft seal to prevent leakage of pressurized fluid during op-



MOTOR-PUMP for missile-borne electronic cooling system is one important application of new subminiature vane pump. Driven by 400 cps motor, unit shown provides 0.3 gpm at 800 psi and 12,000 rpm, weighs only 4 lb. Other application areas include fluid transfer and fluid pumping in control systems. Pump also may be driven directly (without gear reduction) by air and gas turbines because of its high speed capabilities, ranging from 8000 to 26,000 rpm.

PUMP PERFORMANCE varies with displacement, speed and temperature. Typical curves shown are for 0.0105 cu in/rev displacement, 11,300 rpm and 80F. A model of this pump has been run to 30,000 rpm, 500 psi.





FLOW PATHS show operation of pump. Inlet and outlet ports are connected to port areas in faces of front and rear pressure plates. As rotor revolves, fluid is drawn through inlet port into cavity formed by adjacent vanes, then carried across sealing lands between inlet and outlet port and expelled through outlet port for delivery to system. Centrifugal force and hydraulic pressure at base of vanes keep vanes in contact with contours of cam ring to maintain effective seal at vane tips. Hydraulic pressure also is utilized on front pressure plates to provide clamping of cam ring and effective seal on ends of rotor and vanes.

SUBMINIATURE, VANE PUMP CARTRIDGE is 3/4 inch in dia, weighs only 1 oz. Several cartridges are available to provide displacements from 0.003 to 0.013 cu in/rev. Cam ring provides two pumping chambers in opposing quadrants, which balance radial hydraulic forces on bearing. Cartridge is retained in pump housing by snap ring, is readily removable for maintenance or replacement.

eration and to prevent entry of air when idle and during start-up. Prime factors contributing to this problem were: limitations on shaft diameter (0.100 inch), a long shaft overhang and the impossibility of using a fully flexible coupling. Initially, these factors caused a whipping, or deflection, of the shaft which lifted it away from the seal destroying the seal efficiency.

The problem was solved by super-finishing the bearings to tighten up on bearing tolerances, thus reducing whip to a tolerable level, and by incorporating a special seal. This seal is designed so that one coil of a spring holds the seal lip down on the shaft, causing it to follow the whip and maintain the seal.

Another factor contributing to the overall success of the design is the versatility of the material combination used in the pump construction. These materials, which include tool steels, provide a high general contamination resistance and increased durability.

The cartridge won a certificate of excellence in the 1960 Miniaturization Awards Competition. It was cited for "exhibiting ingenuity in solving basic miniaturization problems of broad interest to industry".

The pump was developed by the Vickers Aero Hydraulics Div. of Vickers, Inc., Detroit, Mich., a division of the Sperry Rand Corp.

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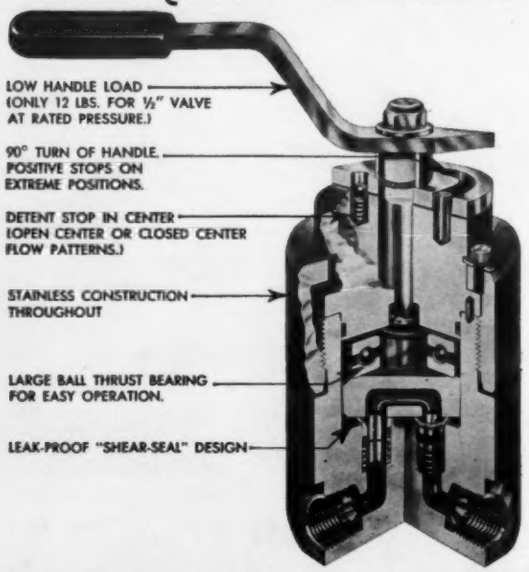
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This new four-way valve series comes in pipe sizes from ¼ to 1 inch, but may be obtained with tube, AND 10050, or any preferred special high pressure connection. It will withstand surges of up to 15,000 P.S.I. without damage to the valve's sealing qualities. It is designed for a burst pressure of 30,000 P.S.I.

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Of course, there is no external shaft leakage, because the pressure is confined to the flow passages.

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Equalizing Hydaulic Rams Lift Saturn Tower on Trucks

Edward W. Schrader, Western Editor

The 28-story Saturn tower, weighing 2800 tons, is raised by large hydraulic rams from anchor rails onto traction drive trucks when self-propelled. The tower rolls on four 12-wheel carriages riding on standard railroad tracks. The gantry is moved 642 ft from the launch pad insuring safety from blast-off effects.

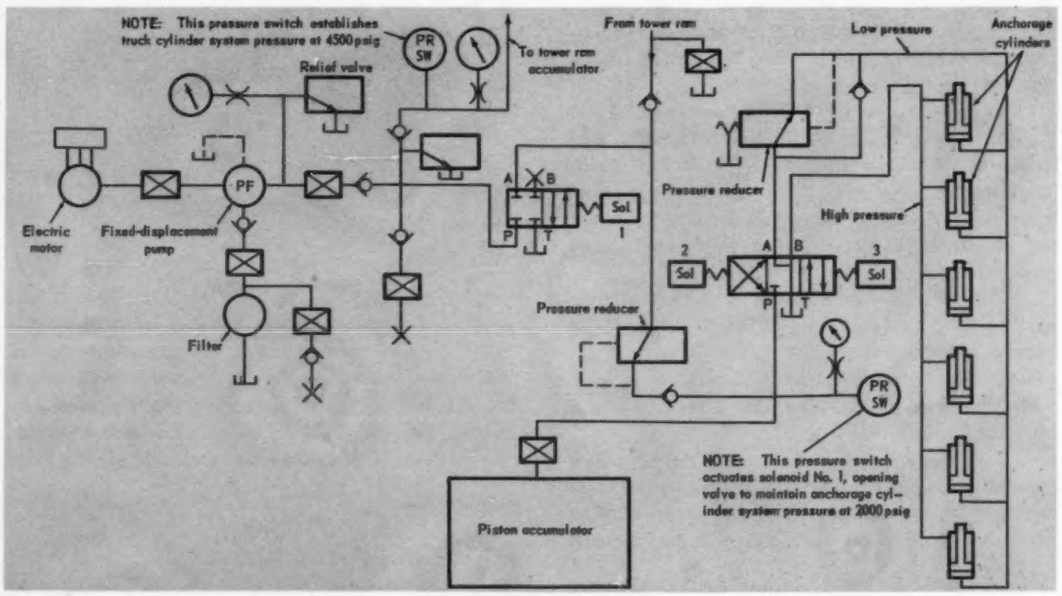
At anchorage position, the tower weight is off the transporting trucks. To raise the load, hydraulic pressure is applied to the self-equalizing cylinders, one cylinder to each of the four-wheel trucks. The cylinders have a 15-inch bore and 7-inch total vertical movement. The end of the ram pushes against a spherical seat on each truck.

The same hydraulic power package also supplies the hydraulic pressure for operating the anchorage cylinders. These cylinders operate wedges to lock the tower down against hurricane winds as high as 125 mph.

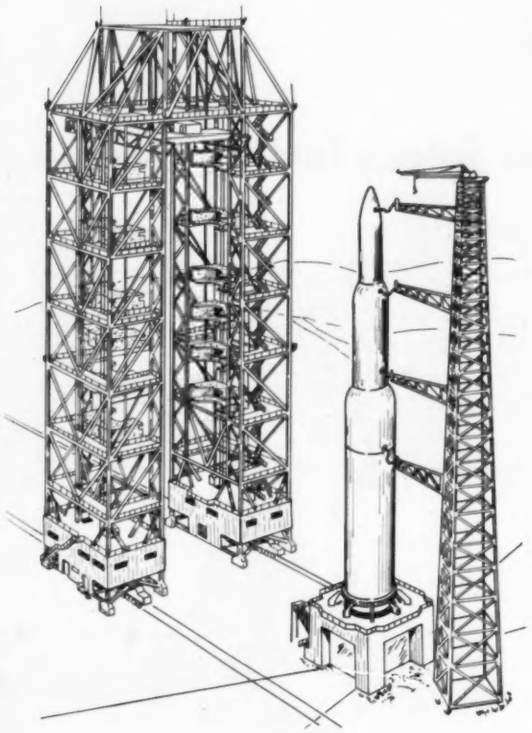
The tower is a completely self-supporting unit containing its own power station, heating and air conditioning, lighting facilities, three elevators and five movable platforms that enable the launch crew to service the booster at different levels.

Each of the platforms is as large as an average three-room house. At the top is a 60/40-ton bridge crane. The crane has two hooks and is capable of moving horizontally, longitudinally and vertically. It can pick up different missile stages at a distance 28 ft out from the center line of the main tower columns.

The tower anchorage system was designed by Joe Stine, Inc., Houston, Tex.; the traction drive trucks and self-equalizing cylinders and bridge crane were designed and built by Pacific Coast Engineering Co., Alameda, Calif.; both under contract to the Fabricating Div. of Kaiser Steel Corp., Los Angeles, Calif. The Saturn tower was built under the direction of the U. S. Army Corps of Engineers at Cape Canaveral, Fla., for the National Aeronautics and Space Administration.

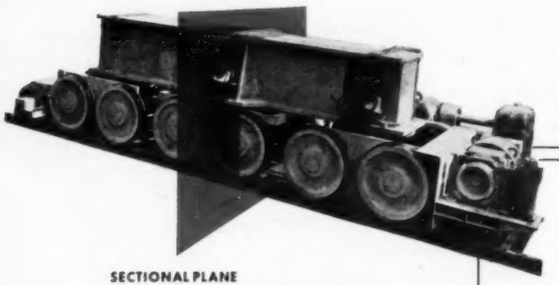


HYDRAULIC SCHEMATIC shows operation of six anchorage cylinders. One double-acting cylinder is located in each inner leg of tower, two in each outer leg. Hydraulic power package uses 15-hp motor and produces truck cylinder system pressure of 4500 psi. Fluid from pump also passes through pressure-reducing valve to limit pressure entering anchorage system to 2000 psig. This pressure is used for retracting locking pin. Fluid is further reduced to 100-500 psig to set locking pin. Hydraulic cylinders drive rectangular-shaped wedges between tower and anchorage track. Setting force is 3000 lb at 100 psig and retracting force is 43,000 lb at 2000 psig.

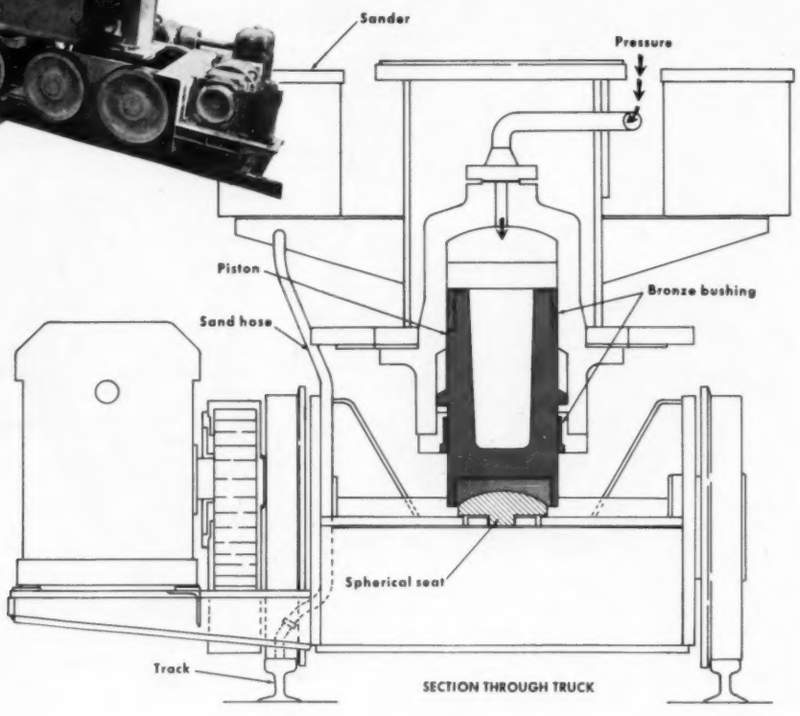


SATURN TOWER will be used to service and assemble Saturn booster. Anchorage can be accomplished in three minutes at either of two different locations. Tower can move away from completed missile to parking position anchorage and be tied down within 20 minutes. It can move along its tracks at 40 fpm against a 35-mph wind.

SELF-EQUALIZING CYLINDERS under 3000 psig pressure raise tower from tie down rails onto trucks. Trucks carry tower load, 2800 tons, only when tower is moving. Pascal's principle (an increase of pressure on any part of confined liquid gives equal increase throughout liquid) causes cylinders within a truck to share load. Equal vertical movement is accomplished by servo metering identical quantity of fluid to each of the four trucks. Tower is raised relatively small vertical distance to keep low-stress level on bronze bushing guides in pistons.



SECTIONAL PLANE



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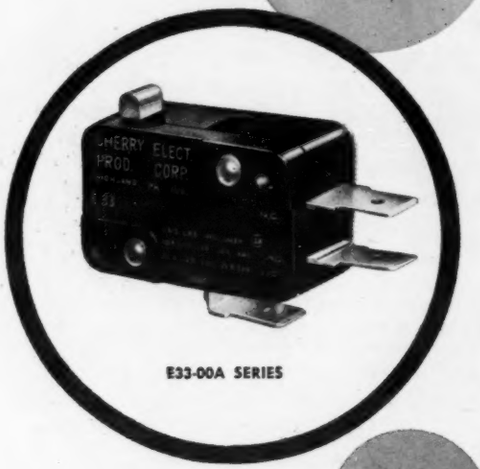

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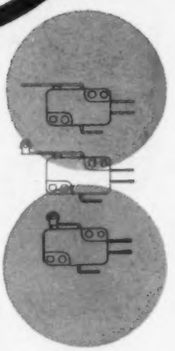

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- Lever Handle and/or Knob cast bronze, polished.
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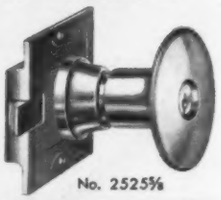
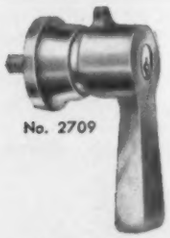


No. 2525⅝



No. 2709

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- Can be masterkeyed in sets with other locks.

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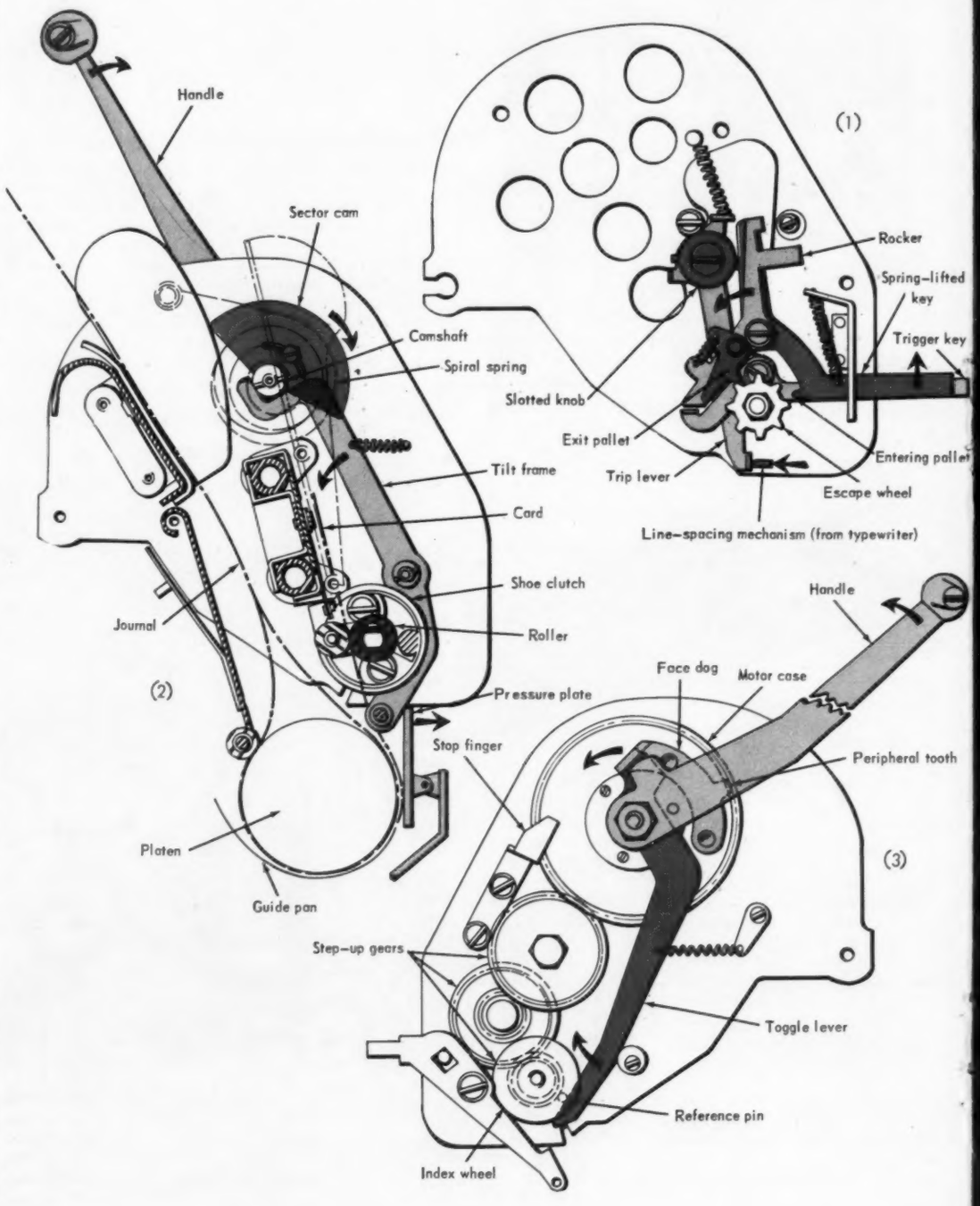
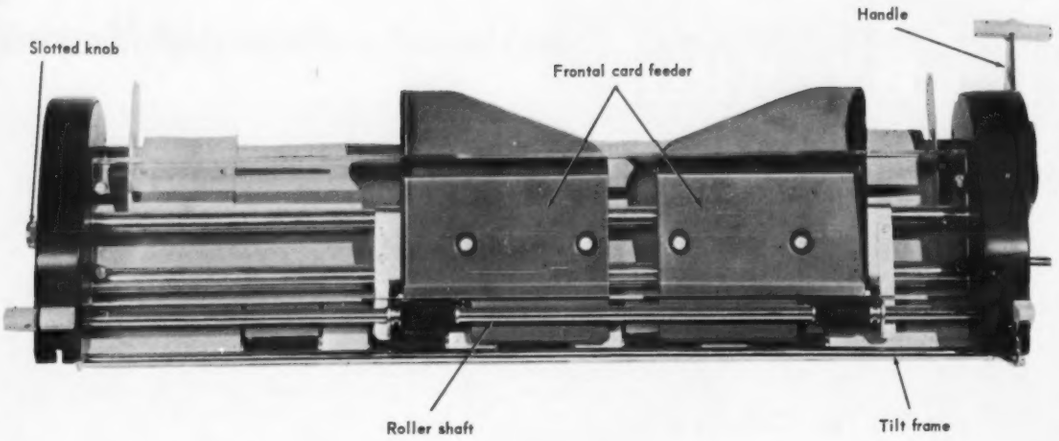
NEW BRITAIN, CONNECTICUT

Circle 10 on Reader-Service Card for more information

Spring-Driven Escape Wheel Speeds Card Positioning

Celestino O. Lubatti, Italian Editor





A card feeder for a standard typewriter utilizes a hand-wound escapement for fast stepping or ejection. The escapement is triggered either manually or automatically by a system of levers holding the pallets. These permit independent movement of the card, as well as synchronous advancement of card and journal. Records typed on various cards are simultaneously transferred to the journal and arranged in wanted form.

A handle winding the spring motor rotates a toothed case meshing with the step-up gear train of the roller shaft. The gears convert the limited handle swing into a complete turn of the roller shaft for fast insertion of the card.

The spring-loaded exit pallet is on a rocker and the entering pallet is on a key turning about the rocker pivot. The escape wheel rotates by half-line spacing when key is depressed and by another half step when key is released. A trigger key lifting the rocker permits complete discharge of the motor spring for quick card ejection. This escapement also can be operated automatically by the line-spacing mechanism of the typewriter. A slotted knob on a trip lever actuates either the rocker or both rocker and entering pallet.

The card feeder, a development by Serio SpA, Crema, Italy, can be mounted on Italian-made "Everest" typewriters and on IBM machines.

(1) SPRING-LIFTED KEY tilts back rocker to engage exit pallet with escape wheel. Coil spring on exit pallet allows backward motion of escape wheel for card insertion. Line-spacing mechanism of typewriter actuates trip lever for automatic stepping or ejection of card. Slotted knob is manually positioned with slot in front of key for card ejection. When slot is facing downward, both rocker and key are actuated; escape wheel steps one tooth per oscillation of trip lever. (2) Frontal card feeder permits quick card positioning or ejection without removing journal. Double feeders utilizing same principle are available for handling two cards simultaneously and independently. When handle is pulled, rubber-lined roller drives card down. Sector cam throws back spring-loaded tilt frame. This inclines transparent pressure plate to direct card edge exactly between guide pan and platen. Spiral spring turns back camshaft as handle is released. One-way clutch (not shown) inside spring motor allows return of handle. (3) Cylindrical case housing motor spring (not visible) carries face dog with peripheral tooth. Tooth contacts stop finger, limiting handle swing. When properly wound, motor spring forces toggle lever clockwise against reference pin of index wheel. Reference pin stops against toggle lever tip after one turn of roller shaft to check card displacement. It is released by crank, spring-connected to toggle lever.

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A Cahners Publication

Assembly Machine

Lars G. Soderholm, Midwest Editor

A connecting-rod assembly machine breaks case-hardened forged-steel connecting rods and reassembles the broken parts (rod and rod-bearing cap) with properly torqued bolts.

To assure optimum mating of the rods and caps, it was decided to make and harden the part in one piece and then to break off and reassemble the bearing cap with bolts. An assembly machine is used to perform automatically this entire operation.

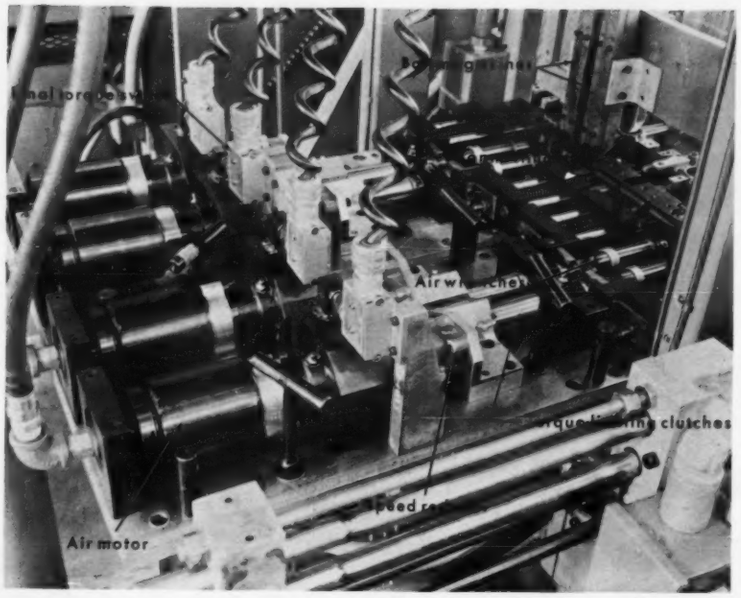
In order to permit a clean break, the carburized forged connecting rod is prepared with two holes drilled through the break line on each side of the rod. The holes are broached to provide small notches at the point where fracture takes place. During the actual breaking operation, tapered carbide probes enter the holes in the connecting rod, two from above and two from below, so that no strain is imposed on the machine itself. Pressure applied to the carbide probes causes the connecting rod to break clean.

There are two different stations where bolts are brought up to torque to reassemble the connecting rod. On both, a moving carriage picks off two bolts and carries them to their place on the rod-bearing cap. Two air wrenches with overriding clutches turn the bolts to get the proper torque when fastening the parts together. If the bolt encounters excessive torque during initial run-in (indicating a faulty thread condition), if the bolt fails to run in to a fully seated position or if the bolt is not fully torqued to within precise torque limits, the part is rejected by the assembly machine at its automatic unload station.

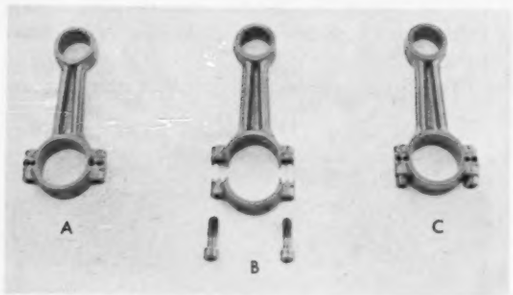
After leaving the assembly machine, the bolted connecting rods are ground, honed and silver-plated on the sides to provide a good bearing surface. Four sets of fixtures are provided to handle 15 different connecting-rod sizes used on 3- to 75-hp outboard motors.

The connecting-rod assembly machine was made by the Gilman Engineering & Mfg. Co., a subsidiary of the Parker Pen Co., both in Janesville, Wis. The machine was developed for the Evinrude Motors Div., Outboard Marine Corp., Waukegan, Ill.

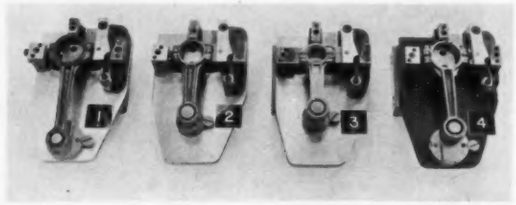
Breaks, Reassembles Heat-Treated Connecting Rods



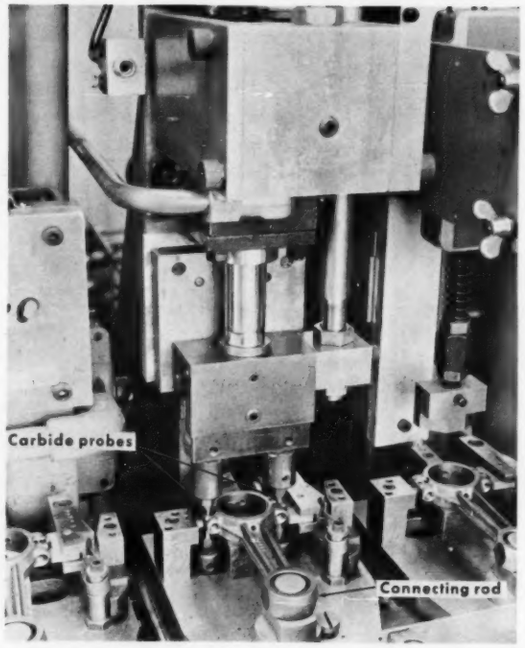
TORQUING STATION consists of moving carriage with air wrench components mounted to pick off bolts and advance them into connecting-rod assembly where they are turned into position and properly torqued.



SEQUENCE OF OPERATION shows (a) connecting rod in one solid piece after initial machining, (b) connecting rod fractured into separate rod and bearing-cap components and (c) fractured sections united and joined by two bolts.



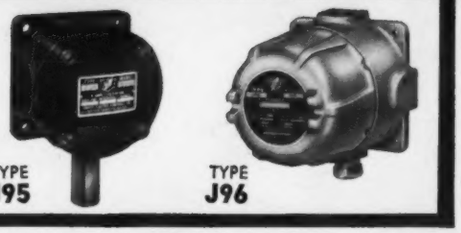
FOUR SETS OF FIXTURES permit 15 sizes of connecting rods to be handled.



BREAKING STATION utilizes four carbide probes that enter drilled holes from opposite directions to exert balanced force for clean fracture.

HAZARDOUS CONDITIONS? J95 J96

Use UE Explosion Proof PRESSURE-VACUUM CONTROLS



The Types J95 and J96 Pressure-Vacuum Controls are designed for applications in hazardous locations where explosive vapors or gases are present and close on-off differential control is required. In both units, pressure settings are uncalibrated and adjustment is made by an internal nut.

Adjustable Range	J95 — Various ranges between 0 and 500 psi limits. J96 — Various ranges between 0 and 180 psi limits.
Switch Differential	J95 — Factory pre-set for any differential between 2 and 30 psi. J96 — Factory pre-set for any differential between 3" W.C. and 2 psi.
Switch Ratings	Up to 15 amps. at 115 or 230 volts A.C. 20 amp. A.C. or D.C. switches also available.
Switch Types	N.O., N.C., or Double Throw — no neutral position.
Maximum Pressure	J95 — Up to 600 psi. J96 — Up to 180 psi.
Electrical Connections	J95 — Lead wires attached to screw type terminals on switch via ½" NPT opening. J96 — Lead wires attached to terminal block via ¾" NPT opening.
Pressure Connection	Via a ¼" female NPT connection.
Enclosure	J95 — Cast iron with a gray, baked-enamel finish. For use in Class I, Groups C and D locations. J96 — Cast iron base and aluminum cover. For use in Class I, Group D; Class II, Groups E, F, and G; or Class III locations.
Mounting	Surface-mounted by four corner holes with clearance for ¼" screws.

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Movement of Optical Prism

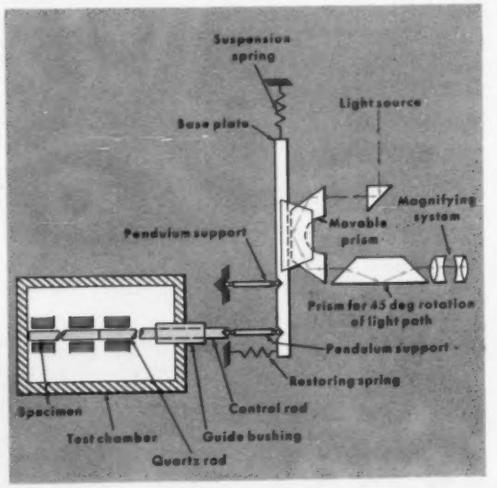
R. F. Stengel, German Editor

A base plate carrying an optical prism is supported at three points of an isosceles right triangle by pendulum rods which are parallel when at rest. One pendulum support, located at the triangle apex, terminates in a fixed bearing point. The thermal expansions of a test specimen and a control specimen are each transmitted to the other two pendulum supports which tilt the base plate about the apex. The resulting prism motion deflects an optical path which serves to register the thermal expansion characteristics of the test specimen.

The base plate is held against the pendulum supports by restoring springs with a total force of only 12 grams. This low compression is made possible by the design of the pendulum support bearings, which permit tilting about a point. Consequently, soft materials can be tested without deformation.

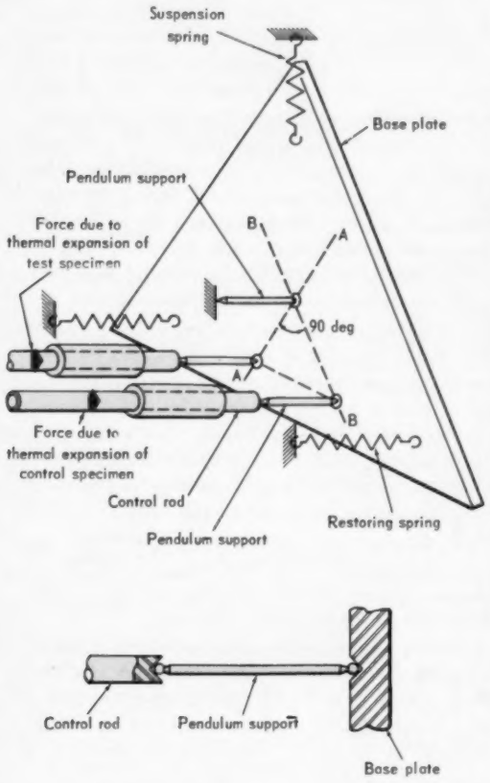
Since either specimen will tilt the base plate about an axis which is at right angle to the tilting axis of the other specimen, two samples of identical material result in a straight-line plot at 45 deg angle. This effect is used to calibrate the dilatometer for expansion versus temperature.

The two specimens (50 mm by 4 mm dia) are



SCHEMATIC SECTION shows optical path, base plate suspension and force transmission from specimens to base plate.

Indicates Thermal Expansion



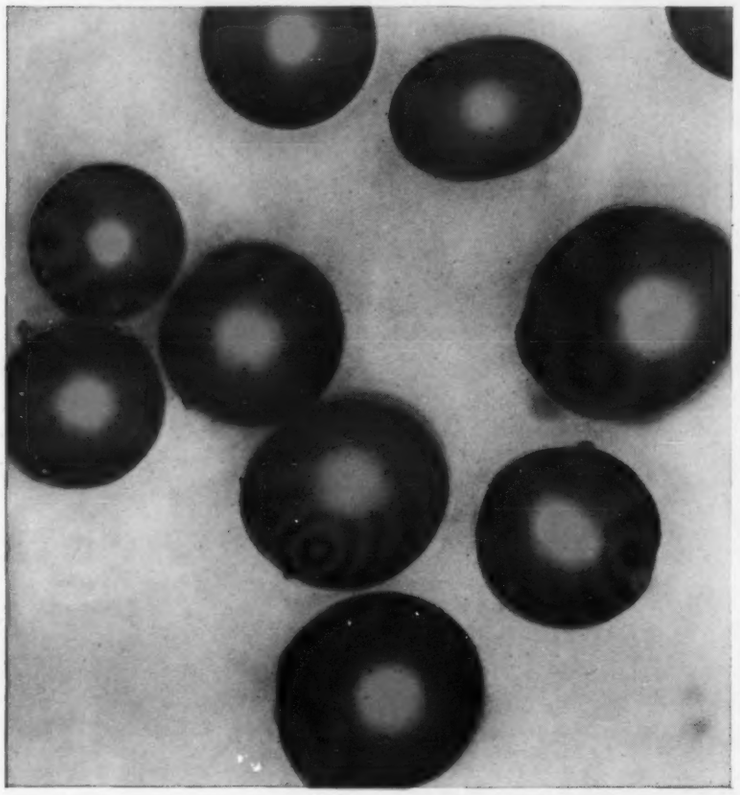
BASE PLATE is suspended by vertical spring, held against pendulum rods by two horizontal restoring springs. Motion of control specimen only tilts base plate about axis A-A; motion of test specimen gives plate motion about axis B-B. Composite motion deflects optical prism mounted on opposite side of base plate.

placed into quartz half-tubes; intermediate quartz rods transmit specimen motion through control rods to the pendulum supports. The test space is heated up to 1100C by a transformer-controlled electric furnace.

Effective optical magnification of the thermal expansion motion is approximately 200X. The deflected light beam is registered by camera or observed directly on ground glass. For time-temperature measurements, a gear motor rotates a drum with photographic paper at preset speed in the path of the deflected light point.

The Dilatometer Model HTV is based on a design idea by Prof. Dr. Bollenrath and manufactured by Ernst Leitz GmbH, Wetzlar, Germany.

30 MILLION OF THESE JET-FORMED SPHERES IN EVERY INCH OF BEARING SURFACE!



JET PROCESS BLASTS MOLTEN ALLOY INTO UNIFORM PARTICLES . . . so small that thirty million will form a thin layer only one inch square! This sintered layer is the bearing surface of Federal-Mogul sleeve bearings.

Molten copper-lead, alloyed to exact specifications, is poured into a special inert-atmosphere reaction crucible. Here it's blasted by a high-speed fluid jet to form the dense powder shown at left.

Because of the uniform particle size of this powder, the bearing surface of each F-M copper-lead sleeve bearing has precisely the same alloy composition and high adhesion to the steel backing as every other F-M bearing of the same alloy type!

YOU CAN SEE THE CONSISTENT SIZE in the photomicrograph. What you *can't* see is the consistent alloy composition which produces uniform bearing properties and performance in any alloy type.

Federal-Mogul makes engine bearings for every condition of speed and load. You can select from among five different sintered copper-lead alloys, all permanently bonded to precision-formed steel backing. Our Engineering Department is available to you for consultation or recommendations on bearing design and application. For more information, write Federal-Mogul Division, 11055 Shoemaker, Detroit 13, Michigan.

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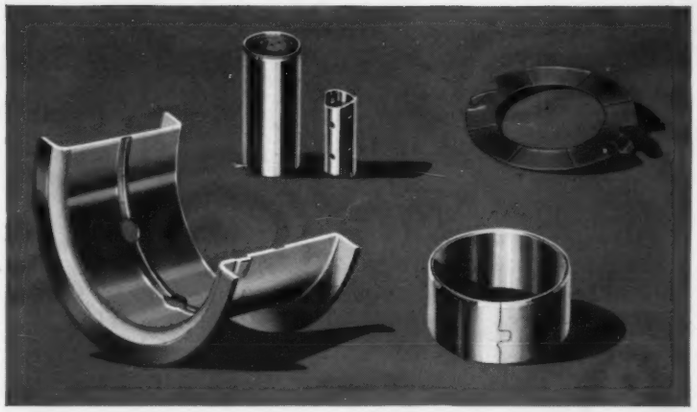

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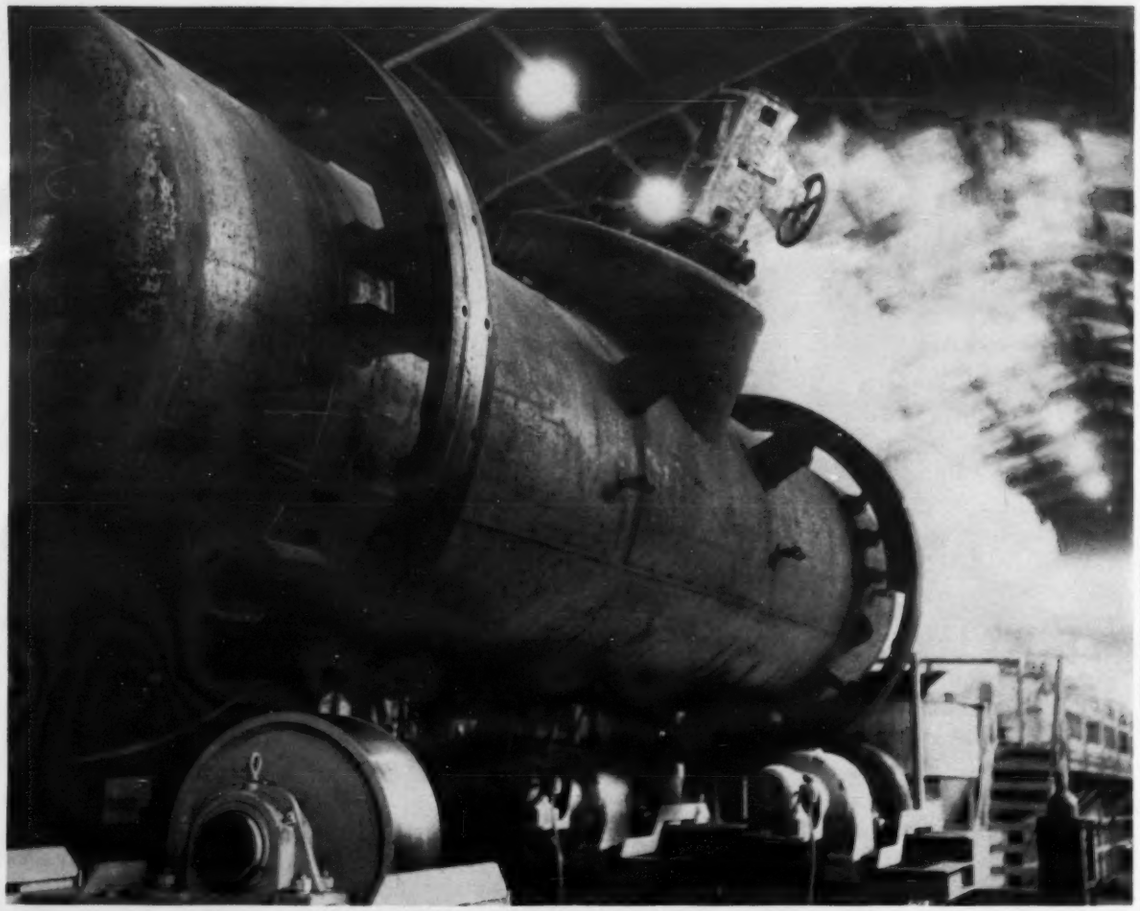

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135 South LaSalle Street, Chicago 3, Illinois *Offices in principal cities*

Circle 16 on Reader-Service Card for more information

PATENTS

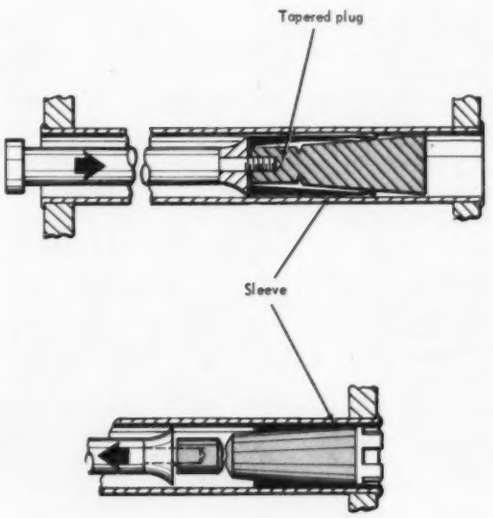
Tube-Plugging Device

British Patent 852,216; Esso Research and Engineering Co., Elizabeth, N. J.

A tapered plug, with a cylindrical end piece separated by a V-shaped groove, is wedged into a sleeve with integral end clips to close the leaking tubes of a heat exchanger. The groove functions as a mechanical fuse which is broken by pulling when the plug and sleeve are fixed in the tube end. The design permits removal of leaking tubes from a bundle without dismantling the entire heat exchanger, condenser or cooler.

The plug is assembled on a rod end by a stud with interposed flared collar. When a tube requires plugging, one header cover is removed and the entire rod/plug assembly is pushed through until the tapered plug and sleeve beyond the collar project just out of the tube end. The rod then is pulled back, the flared collar guiding the plug assembly back into the tube until the sleeve clips engage the tube end. Further pulling wedges the plug-tapered portion into the sleeve which is held stationary by the clips. Continued pull on the rod snaps off the cylindrical portion at the V-groove. Meanwhile, the plug-tapered portion expands the sleeve to seal the tube end.

After withdrawing the rod, the broken cylindrical portion is screwed off the stud. Rod, stud and flared collar then can be used again with another plug assembly. The open end of the exposed tube adjacent to the other header cover is closed by a hammered-in plug.



The following list compiled from recent issues of the Patent Gazette gives you increased coverage of new patents whose details may be useful to product and machine designers. Copies may be obtained from the U. S. Commissioner of Patents, Washington, D. C. The price is 25c each.

THERMALLY RESPONSIVE ACTUATOR
U S Patent 2,990,716; Bruce D. Butts, North Easton, Mass., assignor to Texas Instruments Incorporated, Dallas, Tex.

MOTION-TRANSLATING DEVICE
U S Patent 2,990,725; James V. King, Bedford, Ohio, assignor to Square D Co., Detroit, Mich.

POWER TRANSMISSION UNIT
U S Patent 2,990,726; David I. McDonald, Cincinnati, Ohio, assignor to Nebel Machine Tool Corp., Cincinnati, Ohio.

SPEED REGULATOR SYSTEMS OR MECHANISMS
U S Patent 2,990,825; John L. Fuller, Shaker Heights, and William A. Wickline, Willowick, Ohio, assignors to Curtiss-Wright Corp.

HYDRAULIC VARIABLE-SPEED TRANSMISSION
U S Patent 2,991,619; Paul R. Powell, 205 Stony Run Lane, Baltimore 10, Md.

UNIVERSAL-JOINT CENTERING DEVICE
U S Patent 2,991,634; Frank R. L. Daley, Jr., Fenton, Mich., assignor to General Motors Corp., Detroit, Mich.

MOTOR-DRIVEN SPEED REDUCER
U S Patent 2,991,665; Edward V. Sundt, Wilmette, Ill. (1865 Miner St., Des Plaines, Ill.)

HYDRAULIC CONTROL VALVES
U S Patent 2,991,761; Clarence W. Tydeman, 800 Broadway, Redwood City, Calif.

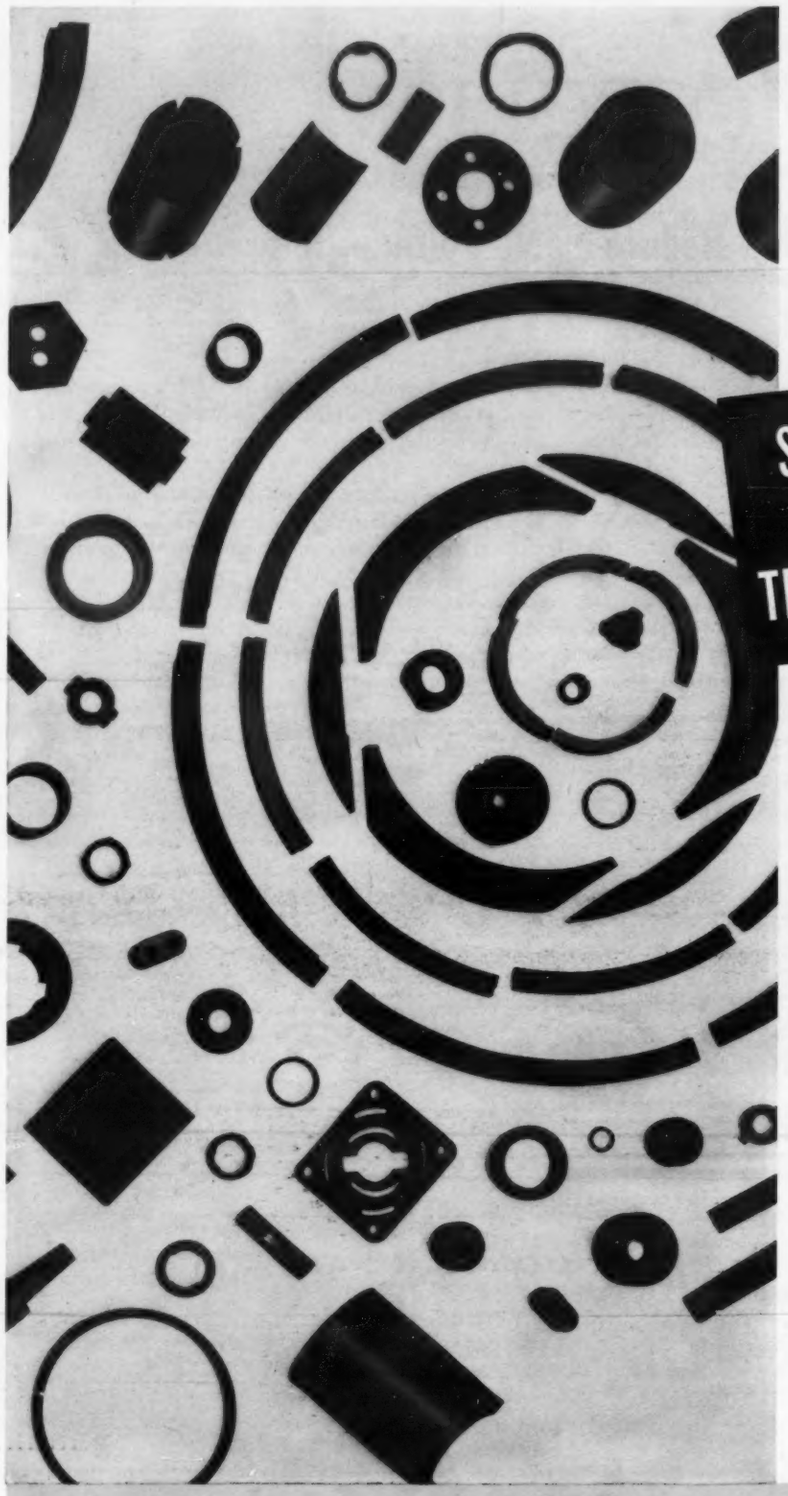
SINGLE-POPPET CONTROL VALVE
U S Patent 2,991,762; Earl R. Price, John W. Blair and Marvin L. Davis, South Bend, Ind., assignors to the Bendix Corp.

DISC BRAKE
U S Patent 2,991,849; Milton E. Erickson, Minneapolis, Minn., assignor to Horton Mfg. Co., Inc., Minneapolis, Minn.

PIPE COUPLING HAVING REMOTELY CONTROLLED HEATING AND COOLING MEANS
U S Patent 2,992,017; Theodore D. Dritz, Wantagh, N.Y.

SELF-LOCKING THREADED COUPLING
U S Patent 2,992,018; Jose Rosan, Newport Beach, Calif., assignor to Rosan Engineering Corp., Newport Beach, Calif.

ROTARY SEAL
U S Patent 2,992,024; Edward F. Barrett, Westchester, and Harry B. Bak, Chicago, Ill., assignors to Victor Mfg. & Gasket Co., Chicago, Ill.



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Varistors Reduce Peak Voltage, Improve Magnet Circuit Performance

E. J. Stefanides, Central States Editor

A new controller for lifting magnets uses the high thermal capacity of varistors to dissipate the inductive energy stored in the magnet field. Varistors are used in conjunction with a selenium rectifier in a circuit to provide greater flexibility and faster operation, reducing maintenance.

One of the major problems involved in the design of a control circuit for a lifting magnet is the safe and rapid dissipation of the energy stored in the magnet field when the lift circuit contacts are opened. Normally, this is accomplished by connecting a fixed resistor in the discharge circuit, allowing a portion of the energy to be dissipated in the resistor and in the arc at the contacts. Energy dissipated and rate of dissipation are proportional to the value of the discharge resistor. Selection of the fixed resistor is a compromise between performance, contact life and maximum-induced voltage stress to which the magnet and lead insulation are to be subjected.

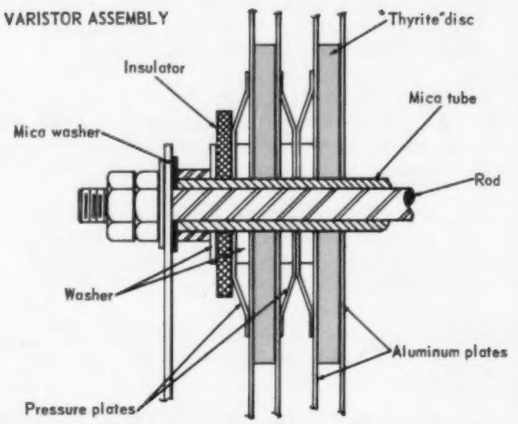
In this design the nonlinear resistance characteristics of a varistor are used to give an optimum solution to this problem. The resistance of the Thyrite* material from which it is constructed varies markedly and inversely with voltage. Typically, it is capable of passing 10 times as much current at twice the voltage, (or conversely, developing only twice the voltage when carrying 10 times the current).

When the varistor is used as a discharge resistor, it provides a relatively low resistance path at high current flow resulting in a considerably lower induced voltage peak. It also provides a higher resistance at low current flows resulting in an average rate of dissipation as good as the fixed resistors conventionally used. The end result, dissipation of the magnet's field energy, is approximately the same length of time as comparable devices but with the peak induced voltage reduced by approximately 50 percent.

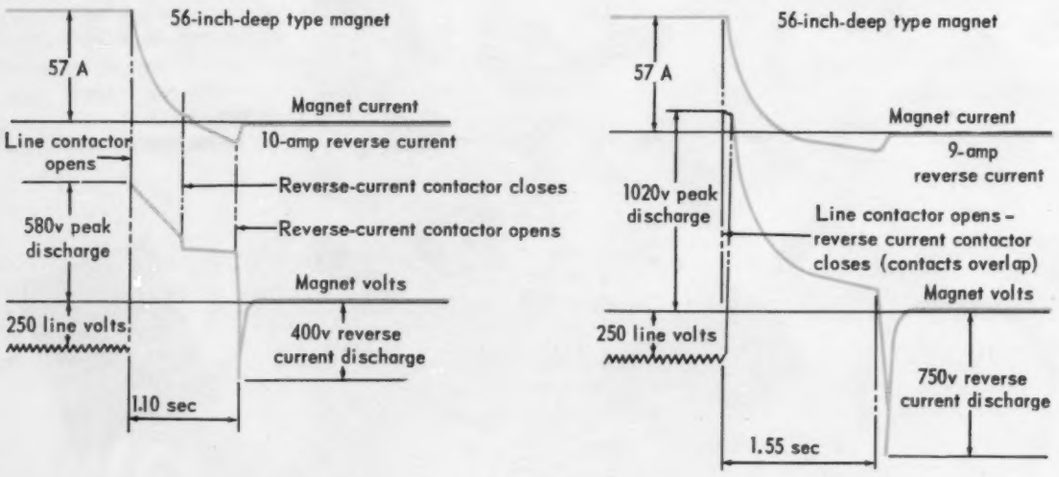
In controllers for lifting magnets two separate contactors are provided. A lift contactor is used to make and break the main power or lift current; a drop contactor to make and break a smaller reverse or drop current which destroys the residual magnetism left in the magnet, to provide a full-clean drop.

In the new controller, the discharge varistor is connected permanently in series with a rectifier, across the magnet on the load side of the lift contacts. The rectifier prevents current flow through the varistor during the lift buildup cycles and eliminates the necessity for dual use of the drop contactor. This results in an increased life for the drop contacts since they no longer are forced to carry the heavy induced current resulting from opening of the lift contacts. It also provides faster operation, as the discharge resistance is eliminated from the reverse current circuit, allowing application of full line voltage for fast reverse current buildup. Conventional controllers, by nature of their circuitry, cannot eliminate this resistance. Finally, this arrangement provides more flexible operation by allowing separate control of the lift and drop current functions. This permits precise partial droppings and dribbling of the load.

This controller is produced in two sizes for control of magnets drawing up to 80 amps and up to 130 amps respectively. It is designed and manufactured by the Euclid Electric and Mfg. Co., Madison, Ohio.

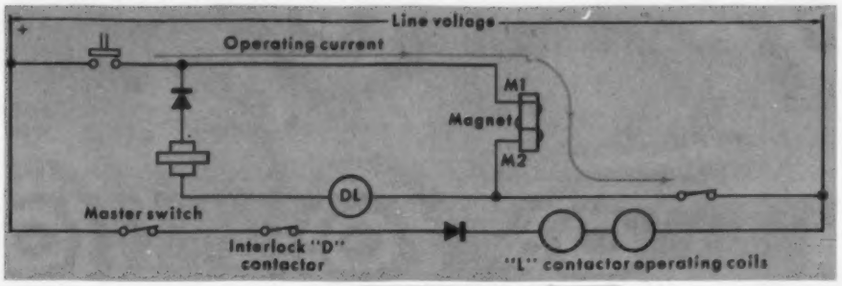


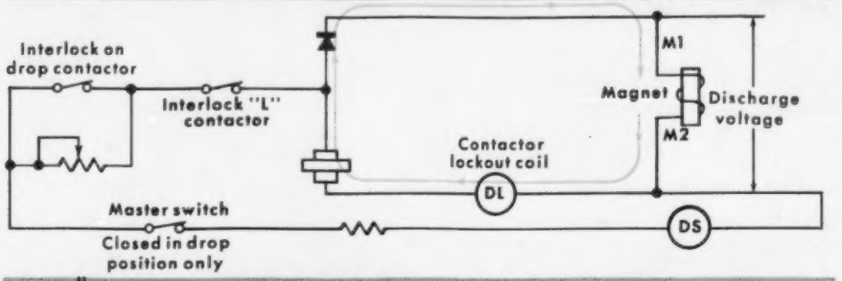
VARISTOR SECTIONS are made up of from 3 to 15 discs (depending on magnet size and ampere rating) of Thyrite*, silicon carbide compound with nonlinear resistance characteristics. Discs are clamped between large aluminum plates, which provide rapid absorption and radiation of heat generated during magnet discharge operations.

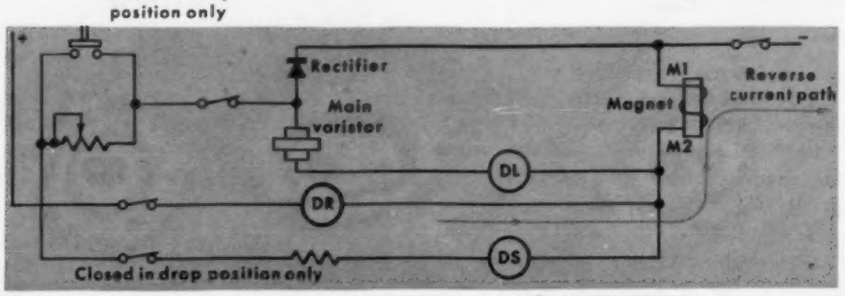


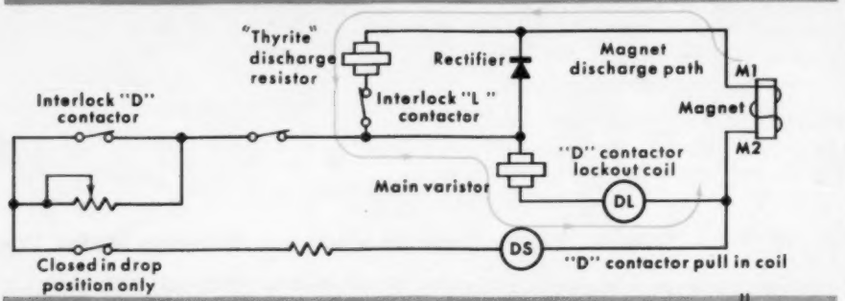
DISCHARGE PERFORMANCE of circuit using varistor-rectifier discharge circuit as compared to conventional control circuit using fixed resistor connected into circuit by drop contactor. Note particularly lower discharge voltage peaks and shorter cycle time of varistor-rectifier discharge circuit. Lower discharge peak voltage (lowering electrical stress on magnet and lead insulations) is expected to increase their service life.

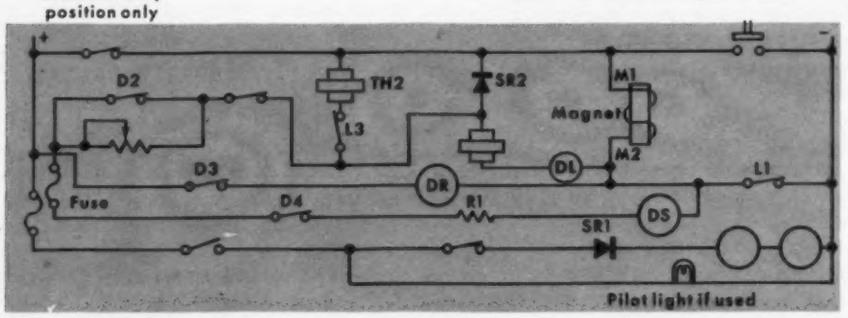
Registered trademark of General Electric Co.











SIMPLIFIED SCHEMATICS showing discharge paths through varistor during lift and drop current energy dissipation cycles. Main rectifier blocks current flow through varistor while lift contacts are closed. Drop contacts are actuated automatically by coil arrangement, which closes drop contacts when current induced by opening of lift contact nears zero and opens them when drop current nears desired value. Potentiometer permits adjustment of this current value to suit magnet or material being handled.

LASTING Eye Appeal

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multicolored textured finish for imaginative designers

In little more than a decade, Plextone has become an accepted industrial finish. Continuous research has resulted in new colors, new design effects, greater durability, wider application. Today, this textured, multicolored industrial finish has reduced costs up to 35 percent. Its one-coat application of two or more interlaced colors is sprayed at **one** time, from **one** gun! Shown above is just one of many pre-mixed Plextone colors available for prompt shipment.

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Design News•Design News•Design News•

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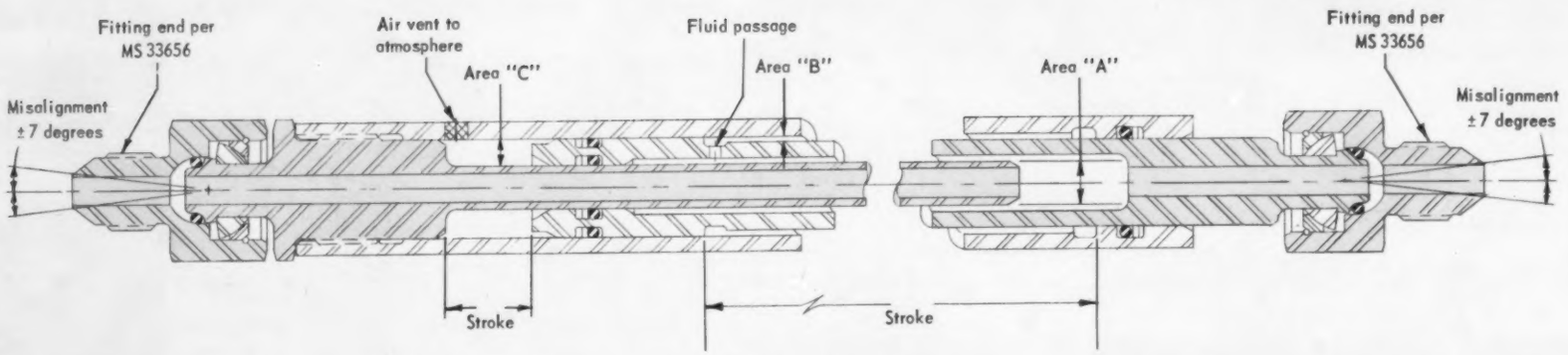
Fluid-Line Swivel Fittings

301

Extend and Retract at Swivel End



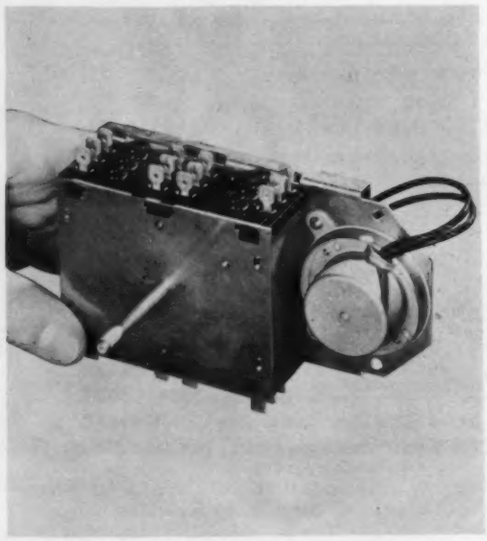
In missile applications, where two completed sections are joined, this unit may be used to connect fluid lines between each section of the missile. Connections are made when the unit is extended fully. Two sections can be brought together, retracting the extended end of the fitting and permitting the missile body to be sealed, with fluid lines inside. The device also can be used in any application where it is necessary to contact a section of fluid line or where motion is involved. In the 1/4-inch tube size, the assembly is only 10 inches long and 3/4 inch in dia. It achieves a full 6-inch extension without leakage. The device can be designed to achieve any extension length desired. It is pressure balanced and is not subject to separation forces. Extension end of fitting also may be rotated a full 360 deg. The balanced freedom of movement from both full-rotation swivel action and linear-extension feature prevents stresses from arising in tubing because of twisting, turning or thermal expansion and contraction. It operates at temperatures from −65 to 300F and pressures up to 5000 psi. Self-aligning fitting ends provide ±7 deg compensation for misalignment at each end.

Dumont Engineering Co., 1401 Freeman Ave., Long Beach, Calif.

Sequence Timer

302

Utilizes Crank-Drive Mechanism, Extends Motor Life



An unusual feature of this drive is that the motor is required to deliver only the amount of torque needed during a particular pulse. The crank-drive mechanism has been designed for optimum efficiency and reliability. The no-back and pawl operate from the same ratchet wheel tooth, and special springs assure proper engagement to ratchet wheel. The mechanism utilizes a split nylon bearing in the crank gear for longer wear. The cam stack assembly consists of individually molded phenolic wafers. Each wafer has two cam tracks, plus a flange which holds cam followers in place. Wafers are secured to the die-case ratchet wheel by injection molding of glass-filled nylon into three slots throughout entire length of assembly, assuring a permanent and positive location of cam. The timer utilizes single-pole, single-throw (SPST) switches. Both switches on a given cam can be closed at the same time. In addition, SPST switches operate either in the opened or closed position. With no midposition required, the adjustment for contact gap has been eliminated and reliability has been increased. A one-piece terminal construction on timer switch assembly has eliminated current-carrying rivets. Subinterval switching, for use in certain applications that require switching operations to occur at times other than when ratchet wheel is being advanced, is accomplished easily on this unit. This feature can be built into timer using the same SPST switch, avoiding necessity of "special" designs. Switch box is constructed for maximum rigidity. Flat stamped spacers are used in ends of box in place of screw machine posts. Tests under a torque of 50 lb-in showed a twist of only 0.1 deg. Timer is available in nine different pulse intervals from 30 to 180 sec. Timer offers a choice of pulses up to a maximum of 72 per cycle.

General Electric Co., Schenectady 5, N. Y.

Clutch-Type Servoactuator 303

Weighs Less Than 1 Lb

Applications which require a high degree of precision with relatively low power are fulfilled with the Series 3170 servoactuator. The rotary component provides high-frequency response, high-torque output and proportional torque control. This control is precise because of the sharp null in clutch torque-current curve. Through use of the building-block principle, the unit is adaptable to a wide variety of instrument-type applications. Operating torque range is from 1 to 70 lb-in. Corresponding speed range of from 285 to 4.6 rpm is attained by varying gear-reduction package. A-C or d-c motor and actuator connectors can be supplied as required. Duplication of expensive tooling and design costs is avoided, making the particular model in the series a shelf item, available on short notice at low cost. A companion amplifier, measuring 2-1/2 by 2-1/2 by 2 inches, has been developed to drive the servo.

Lear, Inc., Electro-Mechanical Div., 110 Ionia Ave., N. W., Grand Rapids 2, Mich.

WE BROKE A DOZEN SCREWS, BUT

we couldn't make this sheet metal insert spin in its hole!

THE INSERT PROBLEM

A hole punched in thin sheet metal doesn't provide enough surface for threading. You often have to supply the threads by installing an insert.

But the same hole doesn't provide much surface for *gripping*, either. The insert spins.

WHAT WE DID ABOUT IT

The insert we tested was designed with an *angular* knurl around a cone-shaped gripping perimeter. Here's what happened:

First: When we mated the sheets, put in a screw, and tightened it in the insert, the screw pulled the insert toward the sheet. It also pulled the teeth of the angular knurl more firmly into the edges of the hole, increasing their resistance to spin.

We broke screws (No. 8, 10, 12, and 1/4 sizes) by overtorquing them. But the only effect on the insert was to tighten it.

Second: When the insert was first pressed into the hole, the angular knurl displaced metal, squeezing it toward and into a groove around the bottom of the insert. This locked the insert against being pushed out before the screw was tightened. After tightening, the lock was intensified by the added squeezing pressure of the angular knurl.

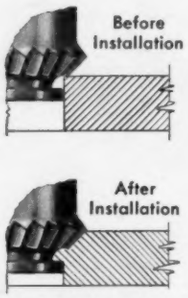
WE'LL SEND SAMPLES

If you've had this insert problem, drop us a line on your letterhead. We'll send some Southco THREDS (that's their name) for you to try. No obligation, of course. Write Southco Div., South Chester Corporation, 232 Industrial Highway, Lester, Pa.

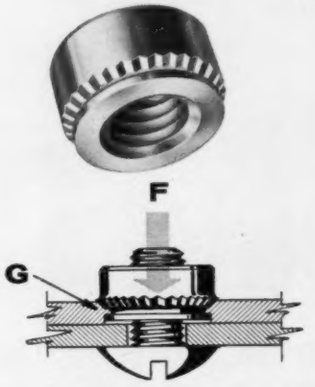
THREDS . . . AND THE ANGULAR KNURL PRINCIPLE

Southco THREDS are installed by pressing into a single hole in the sheet, provide thread length equal to or greater than that of a standard nut. One insert fits any sheet thickness (see minimum requirement, last column in table below). Material is case hardened steel, Cad. plated per Fed. Spec. QQ-P-416 Type II, cl. 2, yellow iridite.

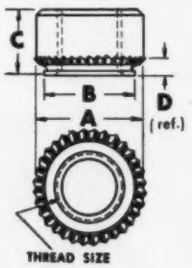
ANGULAR KNURL (detail)



Teeth bite into edge of hole, force metal into locking groove at base of insert.



Additional torque on screw increases force F, pulling teeth of angular knurl more firmly against sheet and putting extra pressure on metal in locking grove G.



SOUTHCO THREDS T.M. . . . SPECIFICATIONS

THREAD SIZE	PART NUMBER	A	B	C	D	Weight per M (lbs.)	Min. Sheet Thickness
4-40 NC	74-11-104-13	7/32	.185	5/32	3/64	1.22	.036
6-32 NC	74-11-106-13	5/32	.247	5/32	3/64	1.99	
8-32 NC	74-11-108-13	5/16	.278	3/16	3/64	2.87	.048
10-24 NC	74-11-110-13	5/16	.278	3/16	3/64	2.51	
10-32 NF	74-11-210-13	5/16	.278	3/16	3/64	2.53	
12-24 NC	74-11-112-13	13/32	.372	3/16	1/16	4.56	.060
1/4-20 NC	74-11-125-13	13/32	.372	3/16	1/16	4.28	
1/4-28 NF	74-11-225-13	13/32	.372	3/16	1/16	4.32	

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SOUTHCO FASTENERS

LION

Circle 19 on Reader-Service Card for more information

increase heating range to

3200°c

with Speer Graphite Furnace Elements

Speer will machine single- or three-phase graphite furnace elements to your specifications. Suitable for operation under vacuum or inert atmosphere conditions, these heating elements are ideal where temperatures in the 1500-3200°C range are desired. They are available up to 30 inches OD or as small as a fraction of an inch in diameter.

Let Speer help you with your problems of heater design. Call or write for further information.

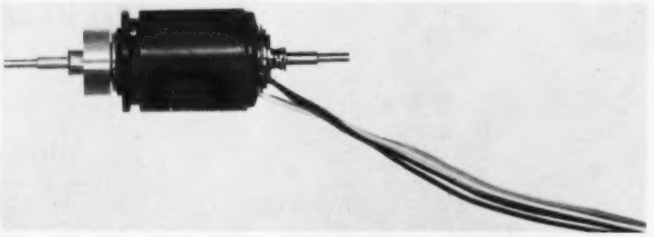
SPEER Carbon Co

Carbon Products Division
St. Marys, Pennsylvania

Circle 20 on Reader-Service Card

Miniaturized Slow-Speed Drive 304

Offers Input-to-Output Ranges of 25:1 up to 5000:1



Basically a drive motor with a miniature gearless speed reducer, this rotary component is designed for light-duty applications, such as potentiometers, slip rings and synchros. Because of backlash and limited torque output, the device cannot be used as a substitute for conventional gearhead motors, but slow speed of the drive offers the advantages of smooth operation, high shock capacity under vibration (20G at 10 to 2500 cps) and extreme compactness. The drive motor-speed reducers are made on order with Size 10, 11 or 12 motors. Single or double-ended shaft output can be obtained. Input-to-output speed ratios are available within the range of 25:1 up to 5000:1 and electrical characteristics are optional depending on requirements.

Barden Corp., Danbury, Conn.

D-C Display Motor 305

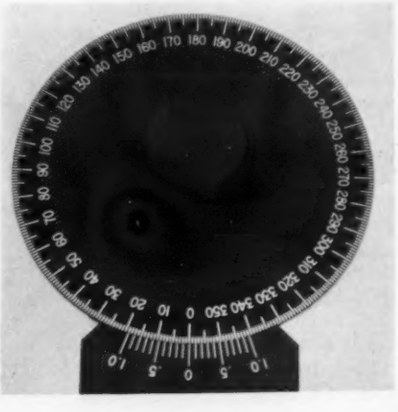
Provides A-C/D-C Interchangeability

Designers and manufacturers of motion displays can choose any standard speed from 4/5 to 1800 rpm and select standard interchangeable d-c or a-c motors for the same display using the low-cost Series 310 d-c unit. This unlimited range of speeds and interchangeability with standard a-c motors assures greater design freedom and economy, eliminating the need for separate designs and assembly for a-c and d-c operation. Powered by two or more standard flashlight batteries, the self-starting 310 unit is reversible for clockwise or counterclockwise rotation. Low battery drain (10 ma or less under no load) assures longer battery life. Suitable for continuous duty from no load through 20 oz-in at 1 rpm, the rotary component is available in standard shaft configurations.

Bristol Motors, Div. of Vocaline Co. of America, Inc., Old Saybrook, Conn.

Precision Dials and Verniers 306

Cover 360 deg Range, Over 6 Minute Tolerance



Designers of mechanical and electronic equipment are offered precision dials and verniers in standard diameters from 2 to 6 inches in 1/2-inch increments. Tolerance of 6 minutes over the range of 360 deg together with TIR of 0.0015 between 0.375-inch hole and OD offer unlimited design applications. When used with vernier, readings of 6 minutes are obtained. Units are available in clear aluminum and in white or black military-specification paint. Graduations and numbers are filled with a contrasting color paint.

Ackerman Engravers, Inc., 43-22 36th St., Long Island City 1, N. Y.

Miniature HP Brakes and Clutches **307**

Ranging in size from less than 1 inch to 4 inches in dia and in torque ratings from 1.5 to 240 lb-in, these units find wide usage in aircraft components, servos, data-processing equipment, instrument drives, computers, testing equipment and similar units requiring rotary drives which cycle automatically or by remote control. Electromagnetic operating principle permits stepless torque modulation and operation from a variety

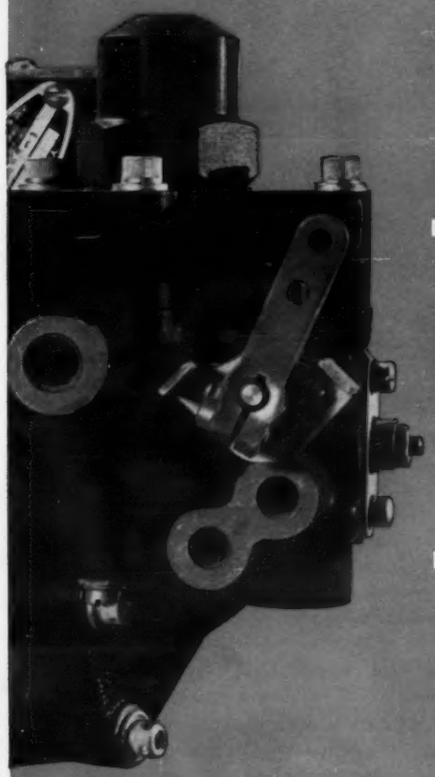
of actuating devices. Among other control advantages made possible by these electric brakes and clutches are precise automatic indexing or speed changing, fast inching and jogging, accurate synchronization and instant reaction at any point of rotation. Units currently in operation are performing at cycle rates to 50 per sec.

Warner Electric Brake & Clutch Co., Beloit, Wis.

Circle 21 on Reader-Service Card

Look at the whole picture before you decide

IT'S EASY TO BUILD DEPENDABLE GAS TURBINE CONTROL SYSTEMS, IF YOU HAVE...



FLEXIBLE, LIGHTWEIGHT Bendix complete control systems for small gas turbine engines weigh less than 5 lbs.

BENDIX EXPERIENCE

- Pioneer in the development of engine control systems
- Manufacturer of more than:
  750,000 carburetors for aircraft
  34,000 fuel injection systems
  97,000 gas turbine control systems and components
- Holder of over 400 patents for fuel metering devices

BENDIX ENGINEERING KNOW-HOW

- Hydromechanical, electronic and pneumatic skills
- Over 600 experienced engineers and technicians
- Extensive computer facilities
- One of the most comprehensive development and environmental test facilities
- Complete qualification test facilities

BENDIX FACILITIES

- 2,200,000 square feet of manufacturing area
- 3,000 modern major machine tools
- Complete foundry and heat treat facilities
- Engine test facilities
- Universal Engine Control for determining engine requirements

EXPERIENCE, KNOW-HOW, FACILITIES, PLUS PROVEN CAPABILITIES IN ENGINE CONTROL SYSTEMS, ARE YOURS AT BENDIX.

Bendix PRODUCTS DIVISION South Bend, IND.

THE Bendix CORPORATION

MARVEL Synclinal FILTERS

FOR DEPENDABLE PROTECTION on all HYDRAULIC and other low pressure circulating systems

Synclinal Sump Type

Capacities: 5—8—10—20—30—50—75 and 100 G.P.M.

Pipe Sizes: ¾"—1"—1¼"—1½"—2"—2½" and 3".

Connections: Coupling—Male Nipple.

By-pass Valve: Not Available.

Synclinal Line Type

Capacities: 5—8—10—20—30—50—75 and 100 G.P.M.

Pipe Sizes: ¾"—1"—1¼"—1½"—2"—2½" and 3".

By-pass Valve: Not available.

Operating Pressures: Up to 80 p.s.i.

Bonded Line Type

Capacities: 10—20—30—50 and 75 G.P.M

Pipe Sizes: 1"—1¼"—1½"—2" and 2½".

By-pass Valve: Available with or without.

Operating Pressure: Up to 250 p.s.i.

Operating Temperatures: Up to 300° F.

In-Line Filter

Capacities: Up to 60 G.P.M.

Pipe Sizes: ¾"—1"—1¼" and 1½" (at both inlet and outlet).

By-pass Valve: Available with or without.

MARVEL ENGINEERING COMPANY
7227 N. Hamlin Ave., Chicago 45, Ill.
PHONE: Juniper 8-6023

IMMEDIATE DELIVERY!

Write, wire, phone or use coupon for information on

☐ Sump Type ☐ Line Type ☐ In-Line
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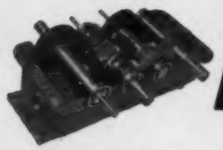
DIFFERENTIAL GEAR BOXES

SPECON



Differential assemblies precision crafted by Specon for drives and transmissions are available as gear boxes alone. These task-proven assemblies offer the built-in advantages of Specon units: extreme accuracy, low maintenance, rugged, space saving construction. Seven basic models are rated from 1 hp. to 75 hp. Specials and units for higher power can be supplied. The Specon units are particularly well suited for such applications as phase and register control, speed control, torque dividing, overriding, cycling and balancing operations.

For full information on Specon gear boxes, drives and transmissions, write to:

STRATOS®

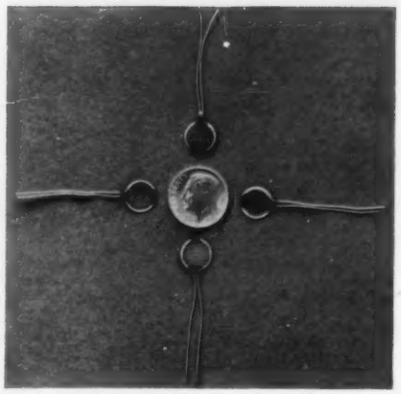
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION
Industrial Products Branch, Route 109, West Babylon, L. I., New York

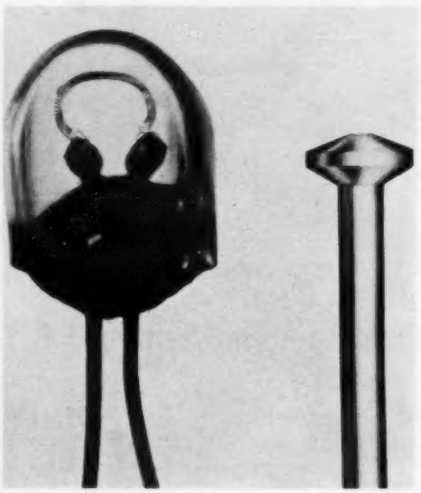
Circle 22 on Reader-Service Card for more information

Light Dependent Resistor 308

A new control device, for use in applications requiring a change of circuit resistance as light intensity varies, measures only 0.42 by 0.06 inch and has a resistance ratio in excess of 25,000:1. This ratio is measured for a light intensity change from total darkness to 1400 foot-candles. LDR (light dependent resistor) has an operating temperature range from −40 to 85C.

Ferroxcube Corp. of America, Saugerties, N.Y.





Subminiature Lamps 309

The design of this "tipless" subminiature lamp series allows light to be taken from the end of the lamp without distortion. The 0.145-inch unit pictured next to a pin head is 7/64 inch shorter than current T-1 models now available, yet it has a life in excess of 10,000 hr. Lamps are stabilized and inspected for narrow candlepower tolerances, resulting in good uniformity. They are obtainable with wire terminals (MS 24367) or based (MS 24515) with ratings from 1.5 to 5.0v and 0.01 to 0.11 amp. Applications include transistor circuitry elements, missile components and panel lighting.

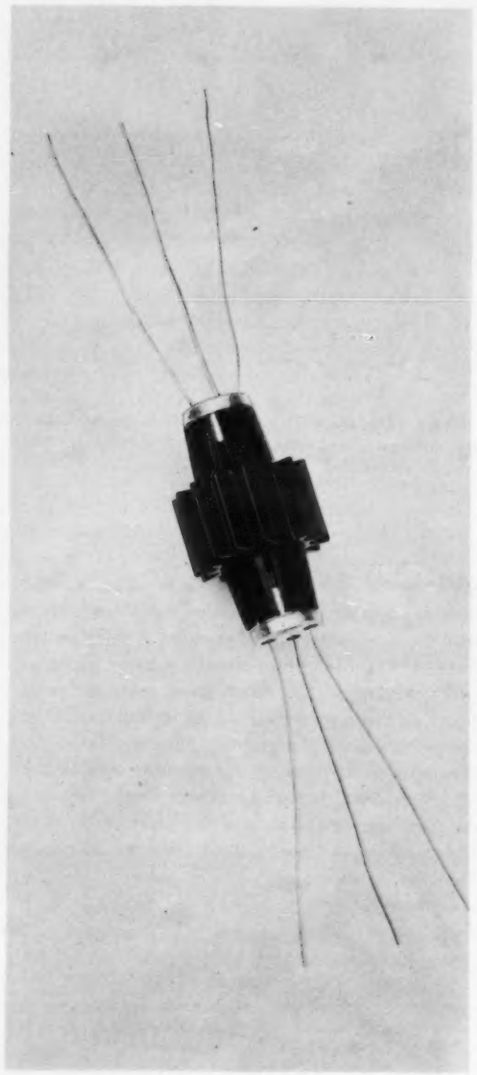
Lamps, Inc., 17000 Western Ave., Gardena, Calif.

Miniature Vacuum Thermocouples 310

This complete range of thermocouples includes both standard types for low and audio frequencies—with heater ratings from 1.25 ma and up—and ultrahigh-frequency types (UHF) for RF applications from 5 ma heater ratings. The UHF types have straight-through heaters and low inter-capacity. Unmounted, open-wire thermocouples are also available for meter manufacturers. The latest addition to this range is a standard type with zero reversal error. Thermocouples to customer specifications, matched pairs and quads are also obtainable.

Barker Sales Co., Dept. DN, 339 Broad Ave., Ridgefield, N.J.

Double-Ended Transistor Radiator 311



Transistors designed into flip-flop or push-pull circuits require only one combination radiator and retainer. This double-ended device will hold transistors in the TO case 5, 8, 9, 11, 12, 29, 33, 37, 38, 39, 42 and 43. Sides of mounting holes are slotted to accept transistor case diameters from 0.310 to 0.325 and 0.475 to 0.490 inch. Slotting also allows for tolerance variations of case diameters. The multi-fin design reduces heat up to 27 percent to extend transistor life and prevent thermal runaway. Material is aluminum alloy per QQ-A-268 and finish is black anodize per MIL-A-8625, Type II. Lengths are 1 inch and heights are 31/32 and 19/32 inch.

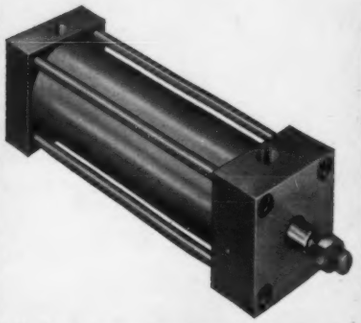
Birtcher Corp., Industrial Div., 745 S. Monterey Pass Rd., Monterey Park, Calif.

NEW FROM HANNIFIN

A GENERAL PURPOSE AIR CYLINDER

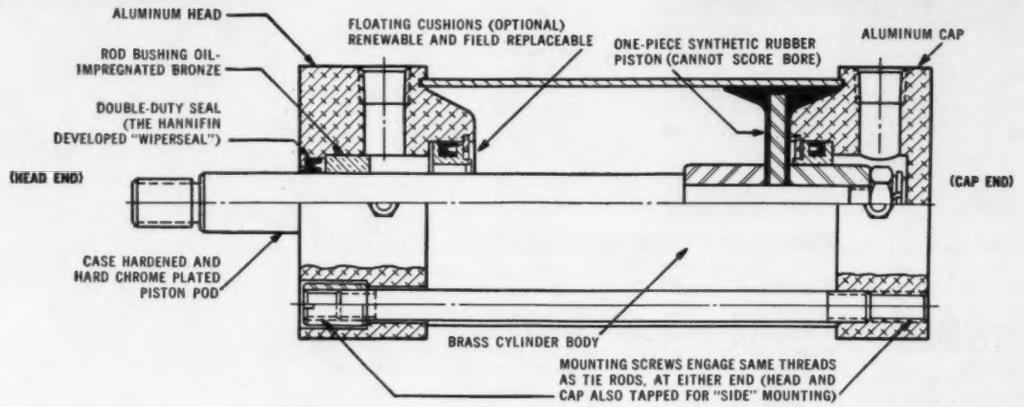
that gives you quality, low cost and mounting versatility

Hannifin announces a new design concept that gives you quality and economy in one package, the new Series "C" air power cylinder with . . .



- One compact basic design that provides side, cap end, or head end mounting without modification.
- Flange, foot or pivot mountings easily made with standard attachments.
- Rust proof construction — brass cylinder body, head and cap of aluminum.
- Cushions that do not change cylinder length—furnished as option or added in field with simple kit.
- An ingenious one-piece piston that cannot score the bore — of synthetic rubber, molded around a rugged steel disc.
- Piston rod both case hardened and hard chrome plated, polished to a fine finish for low friction and long seal life. Corrosion resistant.
- Rod bearing an oil-impregnated bronze bushing. Minimizes friction.
- Gland seal the Hannifin-developed "Wiperseal" — both a rod wiper and an efficient dynamic seal. It keeps air in, dirt out.
- 5 bore sizes—1¼", 1¾", 2½", 3⅛" and 4½". Stock strokes from 1" to 20" in 1" increments.

This new Hannifin cylinder design is the latest of the complete Hannifin line of air power cylinders. To help you choose the best Hannifin cylinder for your application, talk to your nearby Parker-Hannifin man. He knows cylinders!


ALUMINUM HEAD
FLOATING CUSHIONS (OPTIONAL) RENEWABLE AND FIELD REPLACEABLE
ONE-PIECE SYNTHETIC RUBBER PISTON (CANNOT SCORE BORE)
ALUMINUM CAP
ROD BUSHING OIL-IMPREGNATED BRONZE
DOUBLE-DUTY SEAL (THE HANNIFIN DEVELOPED "WIPERSEAL")
(HEAD END)
(CAP END)
CASE HARDENED AND HARD CHROME PLATED PISTON ROD
BRASS CYLINDER BODY
MOUNTING SCREWS ENGAGE SAME THREADS AS TIE RODS, AT EITHER END (HEAD AND CAP ALSO TAPPED FOR "SIDE" MOUNTING)

PARKER HANNIFIN CORPORATION

HANNIFIN COMPANY
A DIVISION
536 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
9420-PH
EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

Circle 23 on Reader-Service Card for more information

► No sliding metal-to-metal contact

► May be used *With* or *Without* Lubrication

► Dead Seal Closing

► Full internal porting on all sizes

Humphrey makes the Simplest Piloted Valve in the World

Inside mechanism of Humphrey "Quick-Dump" Valve

No. 250A ¼" 2-way or 3-way NC piloted Humphrey Valve
List $6.25

No. 125A ⅛" pilot-operated "Quick-Dump"

No. 500A ⅛" pilot-operated "Quick-Dump"

No. 250-4A ¼" 4-way piloted "Quick-Dump"

This is a full ¼" Humphrey "Quick-Dump" piloted air valve delivering 80.04 cfm at 100 psi.

Humphrey has shrunk the valve size and simplified the inside, thereby improving valve performance, lengthening service life, and making installation easier.

Short stroke (.063") plus fast response and built-in quick exhaust give cycling speeds up to 10 cps. Positive dead-seal closing—may be used for valving vacuum down to 5 microns, with air pilot. (Specify vacuum when ordering.) Complete separation of piloting medium from medium being valved.

No lubrication is required. You save cost of oilers, simplify piping, and get oil-free air. (Over-lubrication does not affect the valve.)

Mail coupon today for literature and prices on the Humphrey "Quick-Dump" line.

HUMPHREY PRODUCTS DIVISION
General Gas Light Company
Box 2008 Kalamazoo, Mich.

HUMPHREY *"Quick-Dump"* VALVES

Mail this Coupon for Literature and Prices on Humphrey Piloted – Manual – Cam-operated – Electric Valves

Humphrey Products Div.
General Gas Light Co.
Box 2008, Kalamazoo, Mich.
Please send literature and prices on "Quick-Dump" Valves. We are particularly interested in _____ *valves.*
Firm Name _____
By _____
Street No. _____
City _____ State _____

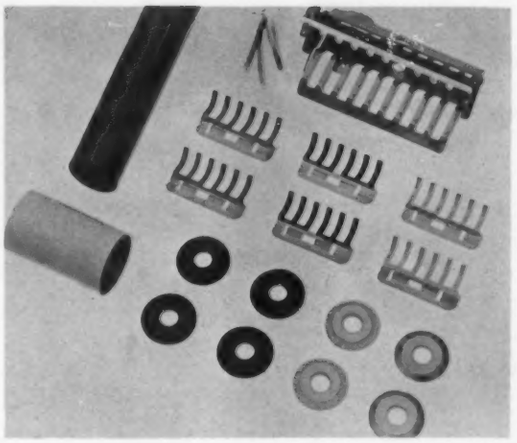
Circle 24 on Reader-Service Card for more information

MATERIALS

Aluminum Enamel Coating 312

Porcelain enamel coating for aluminum is said to be harder than glass and is available with controlled-surface finishes. The enamel shows a hardness of 6.75 on the Mohs' scale. Abrasion resistance is 17 times that of standard porcelains for aluminum as revealed by the Taber abrasion test. Controlled-surface finishes from 6 to 60 μinches rms are available. The material is designed for use where an abrasion-, acid- and solvent-resistant coating is desired for aluminum parts. High abrasion resistance for large surfaces, unobtainable in ceramic form because of size, is now possible. The lead-free enamel can be made in a variety of colors to meet various requirements.

American Lava Corp., Titania Div., Chattanooga 5, Tenn.



SLEEVES FOR HEATED DRAW PINS, tension discs, fingers and gates are shown above with enamel coatings of various colors and surface finishes used in production of synthetic fibers.

Diode Wafers 313

Two standard types of silicon mesa diode wafers are surface passivated and can meet or exceed MIL-S-19500B without any additional sealing. MSC-1 (ultrafast computer diode) has electrical properties of less than 2 nanosec recovery, less than 2 MMF capacitance and at least 75v PIV. MSC-2 (general-purpose diode) has a PIV of more than 300v with less than 10 millimicroamp leakage. Anodes and cathodes are gold plated for ease of termination. Approximate size is 0.020 by 0.020 by 0.007 inch.

MicroSemiconductor Corp., 11250 Playa Ct., Culver City, Calif.

Multi-Alloy Solder 314

A new flux and multi-alloy solder allow easy solderability for rare and difficult metals, such as molybdenum, nickel and chromium. Also, there is the additional advantage for those jobs requiring extra strength on ordinary metals. This combination allows a deeper surface penetration, stronger bond and higher tensile strength on the common metals such as stainless steel, copper, brass and steel. "Nika 40" gives clear sheen with a close fine grain. It is not too hard for working with a machinist scraper. The material accepts cadmium and nickel plate and will solder to aluminum.

Farrelloy Co., 1238 N. 26th St., Philadelphia 21, Pa.

Nylon-Based Reinforced Plastic 315

Featuring light weight and low thermal conductivity, "Tayloron PN" may be used for components where temperatures exceed 4000F for short periods of time. With a specific gravity of 1.20, this material offers a thermal conductivity of 0.71 Btu in/ft²/hr/F at 200F. Made from nylon fabric impregnated with a proprietary high-temperature phenolic resin, this plastic has good physical, thermal and erosion characteristics, and high dielectric strength. It is machinable and exhibits high deflection under load. Sheets, plates, rods and tubes are available either from stock or from current production. Shapes not requiring special tools are obtainable from current production.

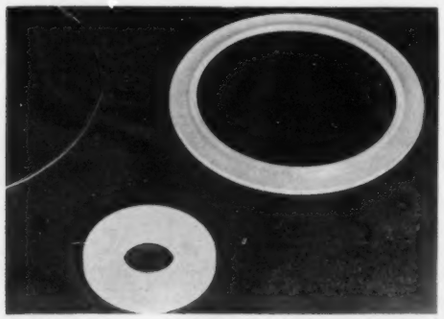
Taylor Fibre Co., Norristown, Pa.

Dry Lubricant 316

Aerosol-packaged "Poxylube" is recommended for laboratory and plant research and production tests; for maintenance and repairs; for breaking in new machinery without undue wear, and for application on limited runs. The bonded-film, solid lubricant offers the user a time-saving method of coating with assurance that the results will be identical when bulk quantities are ordered for production. "Poxylube 750", with epoxy resin adhesive, must be heat cured, after which it is chemically insoluble and has good durability. This container will lubricate 5400 sq in of surface. "Poxylube 420" is a lacquer-resin adhesive that needs only to be air dried for 3 to 6 hr. The aerosol can lubricates up to 3000 sq in of surface. Both materials have the ability to adhere permanently to metal, wood or plastic, with no complicated surface preparation, such as sand-blasting, phosphatizing and other roughening techniques. The lubricants: have continued efficiency under high pressures (250,000 psi) and at temperatures ranging from −100 to 500F; will not collect dirt or dust; do not contaminate foods, beverages or other products, and have long life. They are recommended for roller bearings, ball bearing, levers, springs, valves, locks, flexible shafts, gears, cams, sleeves, rotors and all "problem" lubrication.

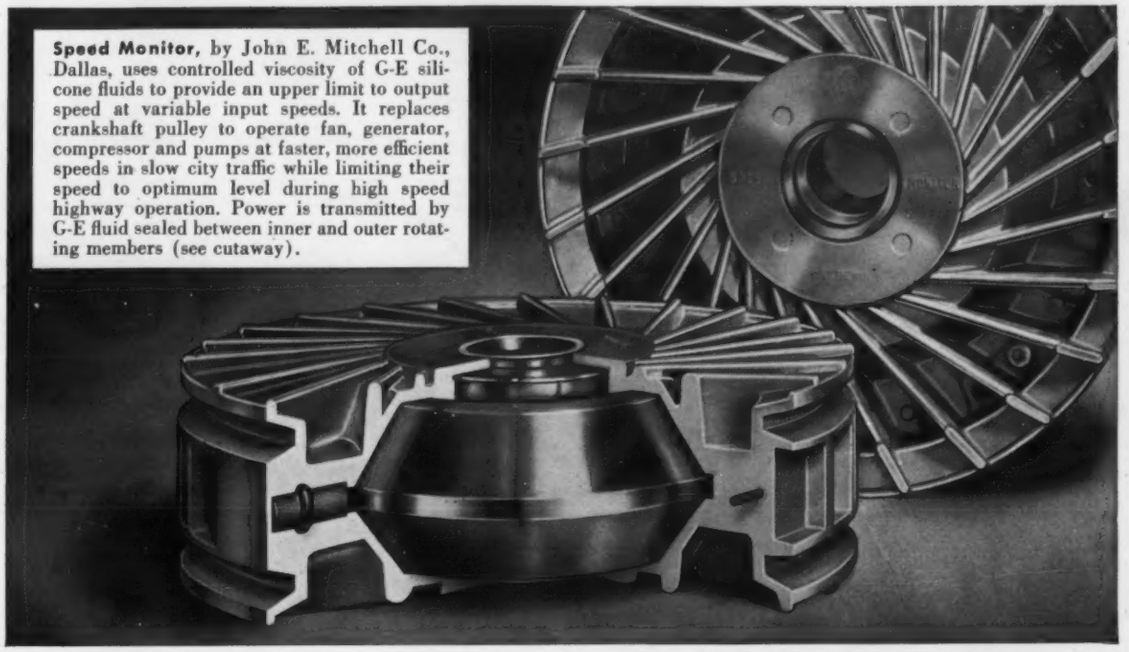
Poxylube, Inc., 541 S. Webster, Indianapolis 19, Ind.

Thermoplastic Resin 317



"Kel-F" 81 is offered in two grades based on molecular weight. The plastic has outstanding low-temperature properties and is resistant to corrosives, making it applicable in the fields of missiles and rockets as well as in conventional applications. Qualities of products made from the material are: resistance to abrasion and to a wide range of chemicals, fuels and corrosive media; zero moisture absorption; infrared transmission abilities; good electrical properties; and thermal stability from −400 to 400F.

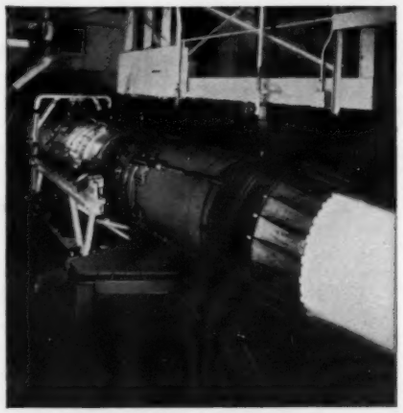
Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

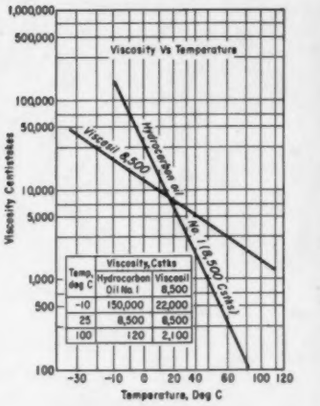


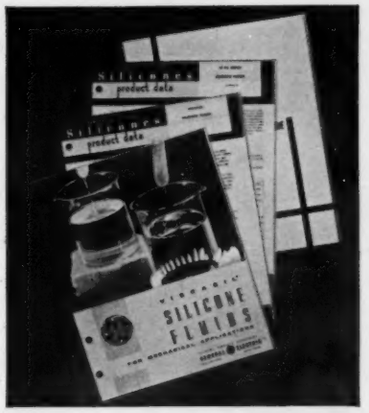
Speed Monitor, by John E. Mitchell Co., Dallas, uses controlled viscosity of G-E silicone fluids to provide an upper limit to output speed at variable input speeds. It replaces crankshaft pulley to operate fan, generator, compressor and pumps at faster, more efficient speeds in slow city traffic while limiting their speed to optimum level during high speed highway operation. Power is transmitted by G-E fluid sealed between inner and outer rotating members (see cutaway).

GENERAL ELECTRIC SILICONE FLUIDS

for reliable performance under tough operating conditions







Thermal stability. The outstanding thermal and oxidative stability of G-E silicone fluids, over an operating temperature range of −100°F to 600°F, makes them suitable for such rigorous applications as jet engine lubricants and aircraft hydraulic fluids. G-E Versilube fluids give unequalled performance at high temperatures and are comparable to other hydraulic fluids in moderate ranges.

Nearly constant viscosity over wide temperature range. G-E silicone fluids exhibit very small changes in viscosity with wide temperature variations. This makes them ideal for many mechanical applications, including fluid drives, dash pots, vibration dampers, timers, shock absorbers, or wherever constant viscosity is needed.

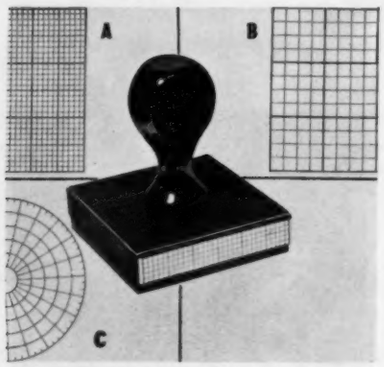
Get the complete story. These bulletins give complete technical data on the G-E silicone fluid line and describe many of the ways in which designers are taking advantage of their outstanding properties. For your free copies, write to Department D853, General Electric Company, Silicone Products Department, Waterford, N. Y.

GENERAL ELECTRIC

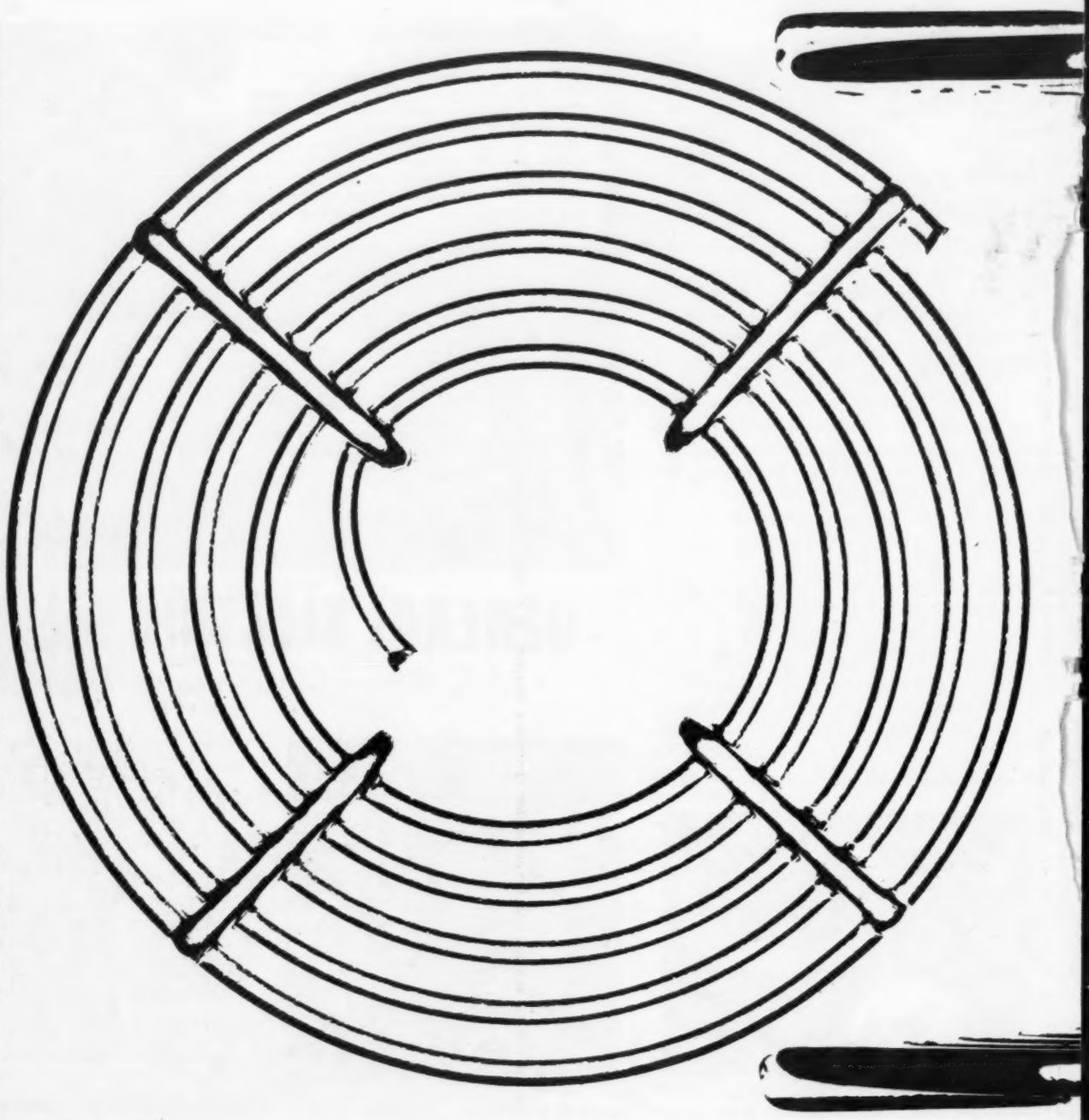
Circle 25 on Reader-Service Card for more information

Graph Rubber-Stamp Kit 318

This useful kit solves the problem of recording graph material entailed in engineering notebooks, reports and correspondence without using bulky sheets of graph paper. The designer can simply stamp a clear graph pattern wherever needed. Kit includes three patterns: a graph of 100 blocks per sq in (for plotting waveform patterns on cathode-ray oscilloscopes); a 1/4-inch grid pattern of 16 blocks per sq in (for plotting in larger scale than the 100-block graph); and a polar coordinate graph stamp, a 3-inch-dia circle with major subdivisions at 15 deg and small markings at each 5 deg. A large 3-1/4-by 6-1/4-inch ink stamp pad is included for use with all stamps. The kit simplifies curve tracing for loci problems in polar coordinates and transformation to polar coordinate problems from Cartesian coordinates. The stamp kit may be used also for electronic design, development and research records, plotting of various curves from analytical data and math formulas and drawing curves from oscilloscope screens.



Edmund Scientific Co., Barrington 54, N.J.



Going round and round on product design? Do it with steel wire!

There is probably not a commercial photographer alive who is not familiar with the intriguing spiral object shown here. It's a developing reel that you load with exposed roll film for developing, fixing, and washing. The film spirals outward, and there is an even space between each layer to prevent uneven concentration of developer solution. ☐ This reel, designed and sold by the Nikor Corporation, Springfield, Mass., approaches perfect design: like a fine machine, it has absolutely no unnecessary parts. It is the most compact reel ever made. It is made from **the** best material to resist corrosive chemical attack: stainless steel. It is made from the strongest, most useful form of steel for this purpose: wire. ☐ Wire is cold drawn in successive passes through dies. This cold working imparts such a smooth surface finish that there is no danger of snagging the film on a tiny imperfection. The reel can be fabricated in jig time on high speed automatic wire forming machines, and because it's made from steel wire it can be permanently joined with one jolt from an automatic welder. There are dozens of film processing reels on the market but professionals continually buy this one because it has no equal. ☐ There are thousands of products that desperately need to be redesigned to retain their place in the market, and an untold number of these products could be drastically improved through the imaginative use of steel wire. Welded wire assemblies, for instance, are amazingly stiff and strong for their weight; and although this is a functional consideration, it has great meaning for the new aesthetics of design that is replacing ponderous and bulky products with those that are airy and graceful. ☐ Wire is manufactured to over 300 billet specifications, from low carbon through alloy to stainless steel grades. It is available in a vast range of hardness and sizes, as rounds, squares, or hexagons . . . in fact, more than **10,000** mill production specifications are available from American Steel and Wire. More than that, we can ship wire in carbon grades in 1,000 pound coils that do not contain a single weld, if required. American Steel and Wire, Rockefeller Building, Cleveland 13, Ohio.

USS TRADEMARK

American Steel and Wire Division of United States Steel

Circle 26 on Reader-Service Card for more information

Liquid Epoxy Dispenser 319

The "Epoxer" will dispense adhesives and potting compounds with viscosities from water to heavy pastes. Fingertip control provides good cutoff, varying from minute dots to a continuous bead. Once the replaceable cartridge is filled with catalyzed material and the unit is pressurized, it is self-contained – no attached air lines are necessary. Cartridges may be filled with material and stored under refrigeration until needed.

Kenics Corp., Box 27, Greenwood Station, Wakefield, Mass.

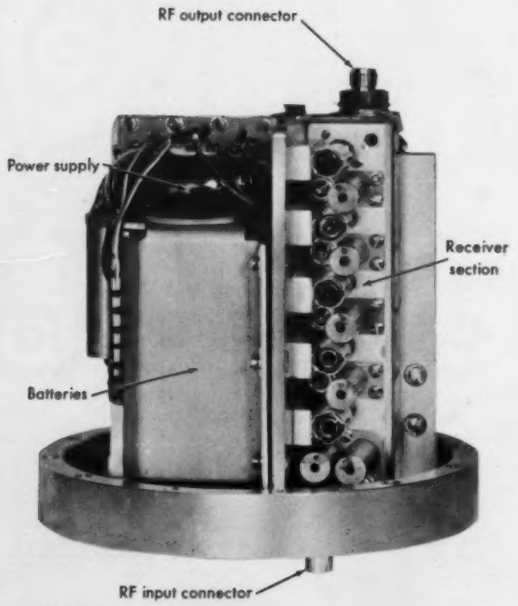
Pocket-Sized Transceiver 320

A 1w, all-transistorized, portable transceiver fills the need for increased range requirements. The compact, lightweight (28-oz), hand-held unit has a rechargeable battery pack with up to 18 hr of usable life before recharging. A battery recharger unit is also obtainable for this model.

Osborne Electronic Sales Corp., 13105 S. Crenshaw Blvd., Hawthorne, Calif.

Brazed Aluminum Mounting Frame Holds Transponder in Nose Cone

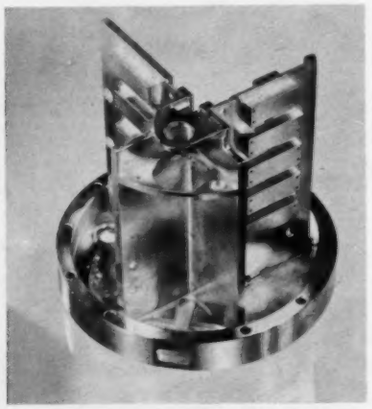
Lars G. Soderholm, Midwest Editor

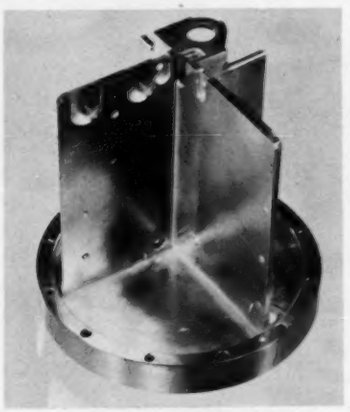


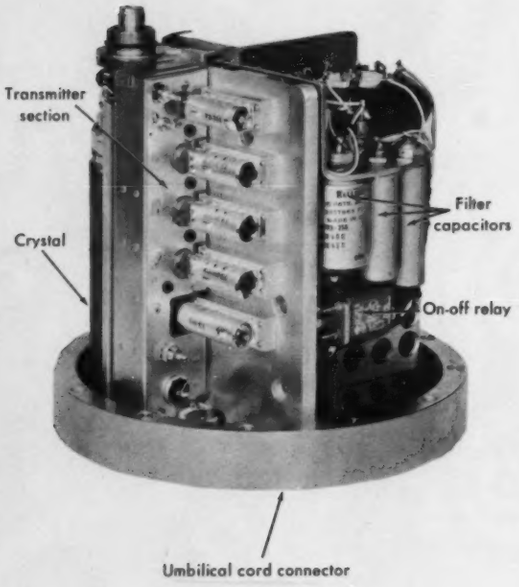
A brazed aluminum mounting frame has many functions in addition to providing rigid support for a transponder located in the nose cone of a rocket used as a target for a missile. In addition to ruggedness, the frame dissipates heat and provides good RF shielding and a good ground for the mounted electrical components.

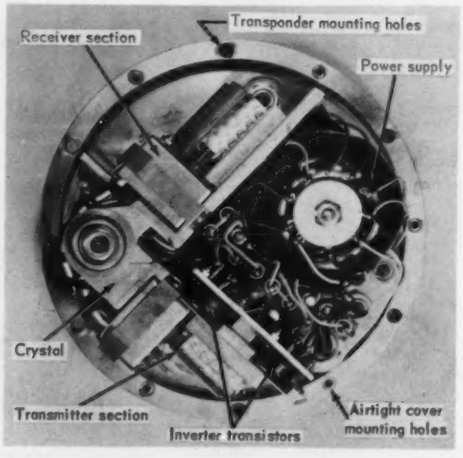
The transponder is part of a scoring system which measures the miss distance between a missile and its target by applying Doppler's principle. A signal from the missile is received by both the transponder in the target and a ground receiving station. The frequency of the signal from the transponder is shifted by the Doppler effect as the missile approaches and passes the target. The frequency shift in time is compared with the reference frequency to determine the actual miss distance.

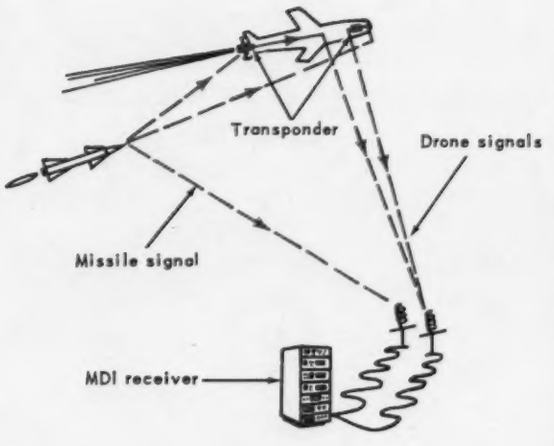
In order to carry properly functioning electrical equipment under high-G rocket environments, it was necessary to design a strong mounting frame. This is provided by a brazed, all-aluminum frame, base-mounted to the rocket. The frame is silver-plated for good RF conductivity and then gold-

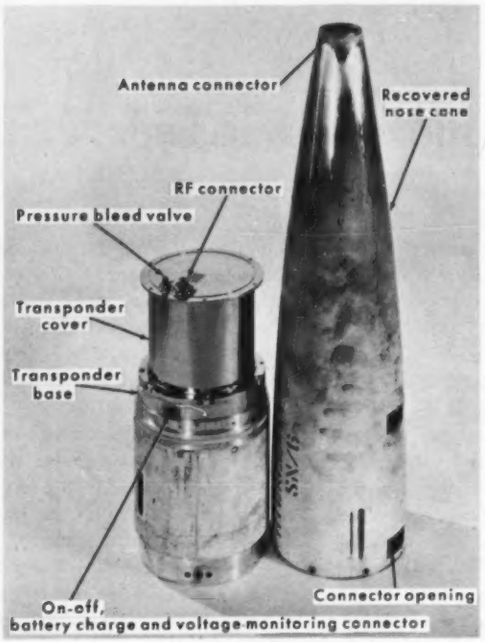












flashed for additional protection.

The aluminum sections in the mounting frame are made with enough cross-section to dissipate heat generated by the electrical equipment through its brazed joints into the base—even in near vacuum. Enough mass is provided in the frame to absorb heat from the transponder for 15 minutes without any other form of heat dissipation.

The transponder itself is a completely self-contained unit with its own battery power supply. Materials used in its construction are all compatible and nonmagnetic. Refinements, such as silicone-filled ceramic tube sockets and "Teflon"-insulated wires, are used for high-temperature operation (up to 125C). Unusually high stability is obtained by using close-frequency tolerance crystals enclosed in an encapsulated, proportional-control oven.

Mounted in the rocket, the transponder is protected by an aluminum cover that is nickel-plated on the outside as protection from the heat of the nose cone and black-anodized on the inside to pick up heat from the transponder. The cover, like the transponder, fastens to a base on the mounting section of the rocket.

A magnetic latch-type relay permits the transponder to be turned on or off through a connector that also is used to charge the batteries and monitor voltages inside the transponder while on the ground.

The ART-3 MDI (miss-distance indicator) Transponder is made by A. R. F. Products, Inc., River Forest, Ill.

DOT® NYLON PUSH-IN NUT

- Non-corroding
- Electrical insulator
- High pull-out resistance
- Straight legs won't distort thin, soft materials

This versatile fastening device snaps into place under finger pressure alone. Its straight legs permit easy insertion in square, punched holes while the tapered screw hole forces the legs apart when screw is inserted and ensures maximum pull-out resistance. Burrs do not impede the nut or prevent proper seating.

Ideal for use in virtually any type of thin-walled structure of sheet metal or plastic, the DOT Push-in Nut does not chip enamel surfaces, locks tightly without distorting the edges of the hole, resists vibration and serves as an excellent electrical and thermal insulator.

Suitable for use with #8 or #10 screws . . . locks in holes from .275″ to .292″ square . . . application thickness range: .030″ to .060″. Spacer type available with ½″ dia. head from ⅛″ to 1 3/32″ length in increments of 1/32″. Other types available in various sizes, round or square-headed, from 1/32″ to ⅛″ thick.

Engineering details and price information available on request.

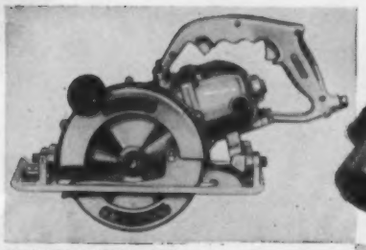
CARR FASTENER COMPANY

Division of UNITED-CARR FASTENER CORPORATION

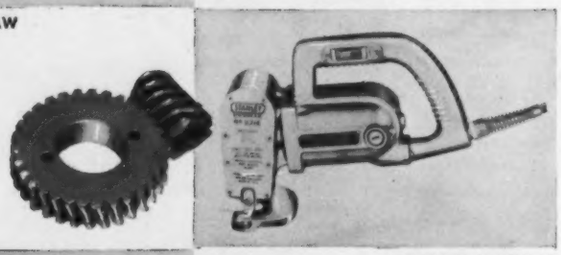
Cambridge 42, Mass.

MAKERS OF DOT® FASTENERS

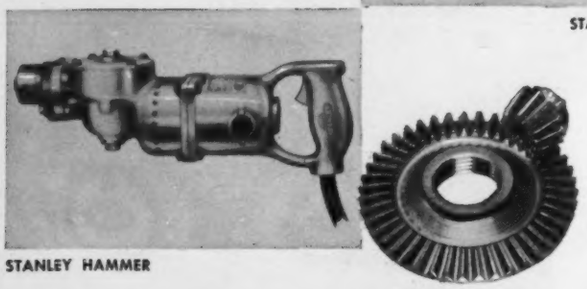
Offices in: Atlanta, Boston, Chicago, Cleveland, Dallas, Detroit, Kalamazoo, Los Angeles, Louisville, New York, Philadelphia, San Francisco, Seattle, Syracuse



STANLEY SAFETY SAW



STANLEY UNISHEAR



STANLEY HAMMER

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Cutting precision gears of all types and sizes to customers' specifications is our business. As part of this, Perkins custom-gear engineers work closely with our customers' designers and production staffs. We can help you too . . . in design, improved performance, and cost control. "It makes good sense to use the help of gear experts with 52 years experience." What are your gear problems?

This Handy Gear Calculator, easy to use, saves time. *Folder* illustrating Perkins custom precision gears and facilities offers information. Both yours on request.

PERKINS
MACHINE AND GEAR CO.
Dept. 94 West Springfield, Mass.
Telephone: REpublic 7-4751

Circle 27 on Reader-Service Card for more information

Plastic Foam Drum Cycles Parts

Edward W. Schrader, Western Editor

A thermal shock-test chamber primarily tests components to military specifications for temperature cycling and thermal shock. Separate chambers must be used for the extreme temperature conditions of the test cycle and room temperature exposures must separate each extreme temperature. Also, each chamber must have a sufficient thermal capacity to attain the specified ambient temperature within two minutes after the components have been introduced into the chamber.

The single-compartment drum receives a greater continuous thermal shock than any specimen placed in the drum for test. To withstand these high thermal stresses, the designers selected Nopco "Lockfoam" for the drum. The cast-in-place foam plastic has suitable characteristics of low density, low thermal conductivity, low coefficient of expansion, adequate shear strength and relative ease of forming. In casting, the material releases gas, forming a cellular plastic mass which expands to the exact shape of the mold cavity.

Sponge silicone rubber, which remains serviceable at temperatures ranging from —90 to 260C, was used for gasket seals between the individual chambers and the drum.

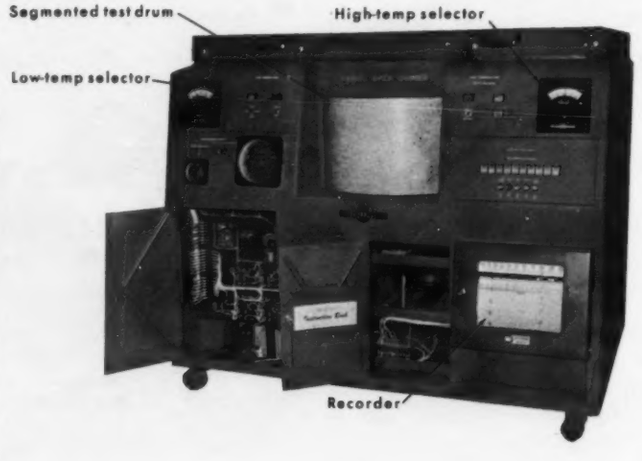
The temperature in both the hot and cold chambers is regulated by on-off cycling. Liquid CO_2, controlled by a solenoid valve, is the coolant in the low-temperature chamber. Expansion of the liquefied gas into the chamber will cool it to —65C in less than two minutes with a room temperature of 25C. The low-temperature chamber stabilizes over the long term at —73C. To preserve the coolant, CO_2 is released only when the test area is in the low-temperature chamber.

Two 600w resistive heating elements heat the high-temperature chamber. Since it requires approximately 20 minutes to bring the high temperature chamber up to 150C from ambient, this chamber is maintained at temperature throughout the entire test period.

Both chambers are lined with stainless steel and insulated with three-inch-thick foam plastic.

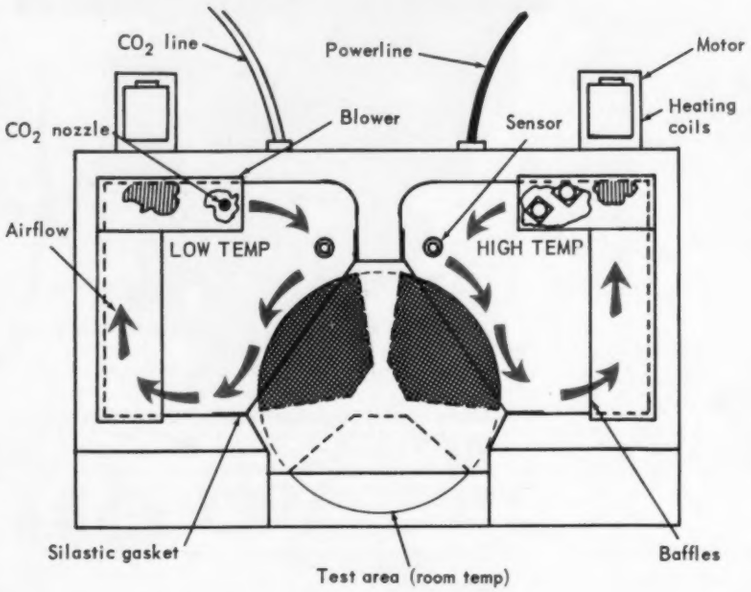
The drum moves from one test area to the next within two seconds. The drive mechanism consists of a set of reduction gears coupled to a 1/3-hp motor through a Dodge "Flexidyne" coupling.

The automatic thermal shock-test chamber is a design development of the Western Div., Collins Radio Co., Newport Beach, Calif.



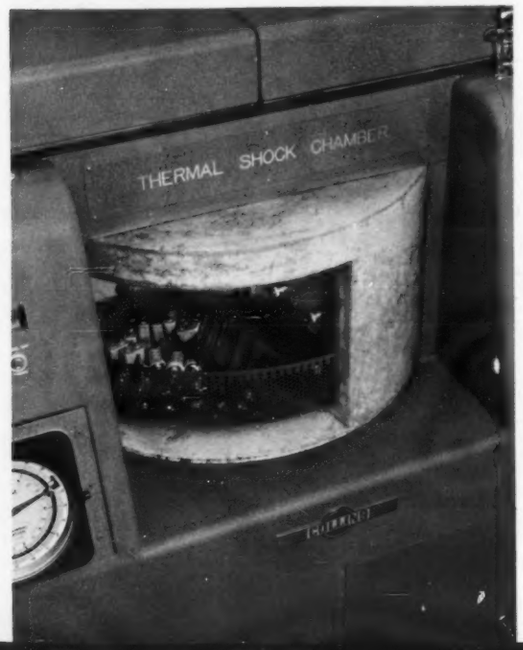
THERMAL SHOCK CHAMBER tests components for temperature cycling per MIL-STD-202B using method 102A and thermal shock method 107A. Unit will control and record up to 10 complete test cycles automatically.

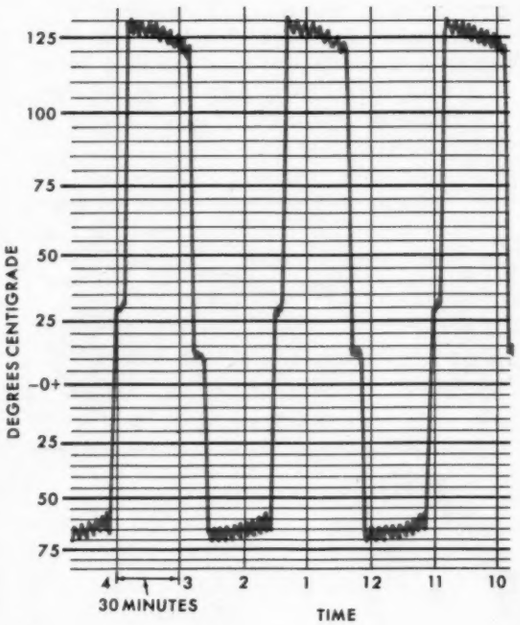
for Thermal Shock Tests



FUNCTIONAL DIAGRAM shows location and operation of major components. Basic unit consists of two controlled temperature chambers separated by segmented test area drum. Reversible rotary-drive mechanism locates test area of drum in one of three positions: low-temperature chamber; high-temperature chamber, or facing outside for loading and room-temperature steps of test cycle. Forced air circulation is used per specification.

TEST RECORD is provided by recorder which keeps linear-time record of test conditions sensed by thermocouple mounted in test area of drum. This is record of actual thermal shock test, per MIL-STD-202B, run automatically. Specified test cycle consists of 30 minutes at −65C (+0C −5C) followed by five minutes at room temperature; then 30 minutes at 125C (+3C −0C) followed by five minutes at room temperature. Figure should be read from right to left.





PLASTIC FOAM DRUM is shown being cycled from room-temperature position to low-temperature chamber. Thermal shock chamber is used for rigid component parts testing and selection program to insure end product reliability.

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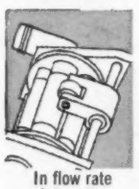

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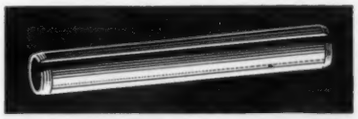

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DESIGN DATA NEWS

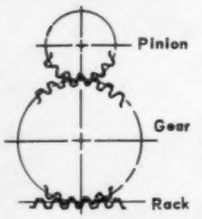
Gearing Nomenclature

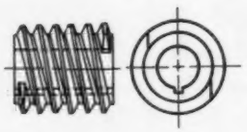
Irwin Koenig, Vice President for Engineering, Foote Bros. Gear & Machine Corp., Chicago, Ill.

Gearing terminology is often a stumbling block to designers who are unable to communicate effectively because of difficulty in describing gears and parts of gears to others. This article gives a brief review of gear nomenclature.

General Designations

Gears are machine elements that transmit motion by means of successively engaging teeth. A GEAR is any machine part with gear teeth. A PINION is the smaller of two meshing gears. A RACK is a gear with teeth spaced along a straight line. A WORM is a gear with one or more teeth in the form of screw threads. Unless otherwise specified, it is cylindrical in form and has helical threads.





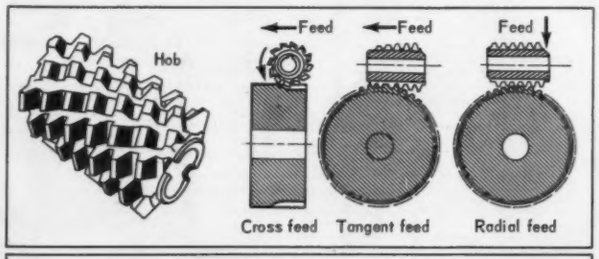
Manufacturing Methods

Gear teeth may be generated, form cut, die formed or press formed.

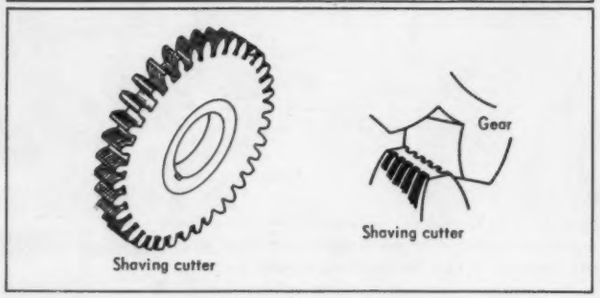
GENERATING means that the tools form the desired tooth shape by hobbing, shaping, roll forming, shaving, burnishing, grinding, abrading or lapping. FORM CUTTING includes injection molding, forging, roll forming, casting, drawing and sintering. PRESS FORMING includes punching.

All operations are classified as roughing, semi-finishing or finishing, and some are done before heat treating, others after. When gears are specified, only those specifications are met. There are inherent imperfections in each method.

HOBBING is done with a special cutter which is fed against the gear blank. Cutting edges of the tool produce the tooth form directly and cutting is continuous.



SHAVING is a finishing operation. Compared with grinding, it is faster. Shaving also is used as a corrective operation. There are two types of cutters—rotary and rack. Rotary cutters have teeth with the same profiles as the gear. As the cutter rotates, the notches scrape off small shavings. Rack cutters have serrated teeth. The gear to be shaved is rolled back and forth over the rack cutter.



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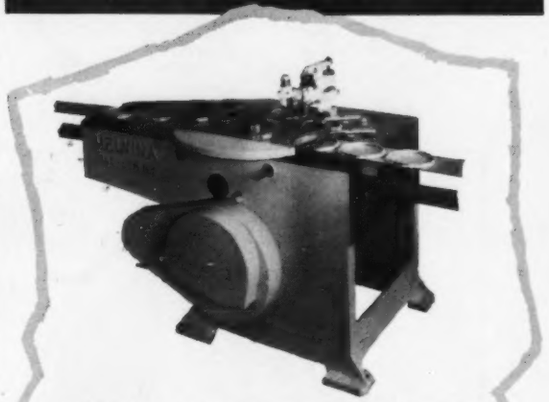

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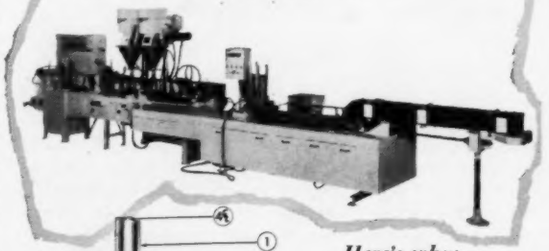

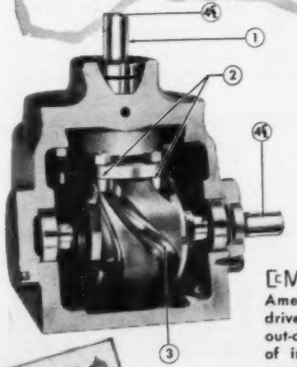

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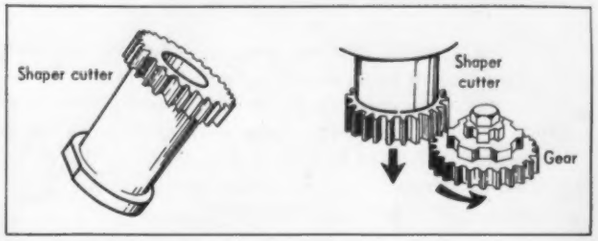
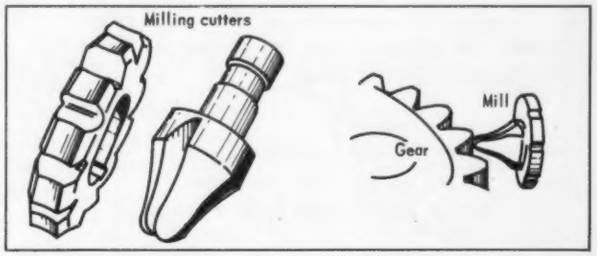
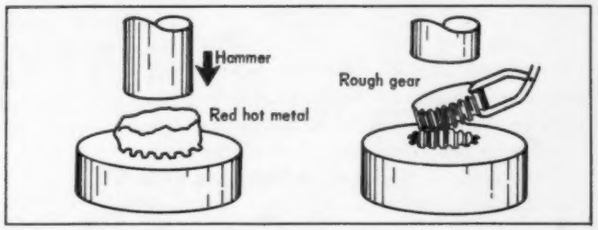
SHAPING is a method using a cutter which is a hardened gear with relieved teeth. The cutter and gear are mounted on parallel axes and cutter reciprocates up and down at several hundred strokes per minute. The cutter is fed progressively into the blank and as cutter and blank revolve, the cutter generates teeth around the blank.



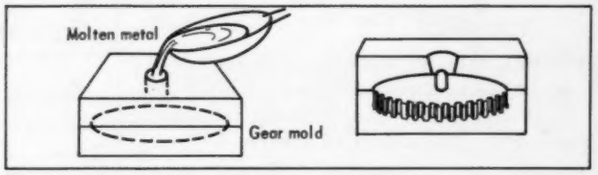
MILLING uses many types of cutters. Profile cutters cut the tooth profile. Plain cutters have a cylindrical shape with teeth on the circumference. Side cutters have teeth on both circumference and sides. Shank and arbor types have cutting edges on one or more angular surfaces.



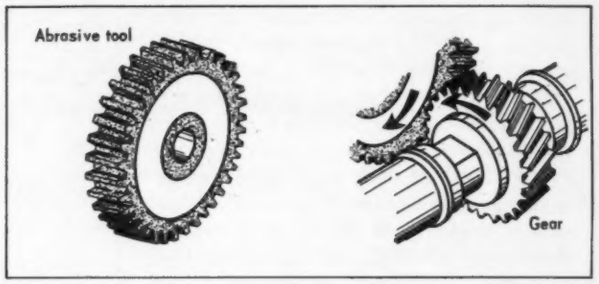
FORGING is a roughing operation for high-strength gears in which hot metal is hammered between tools into the general shape of the final gear. Strength is achieved by the arrangement of the grain structure.



CASTING involves pouring of hot metal into a mold that has the gear shape. There are many types of casting operations, including investment, die, sand, frozen mercury and others.

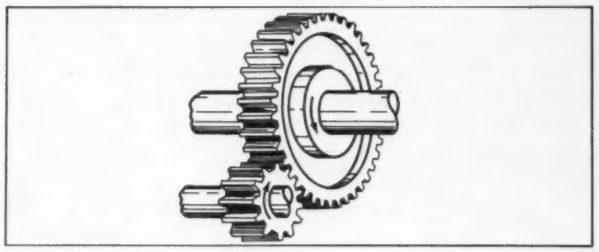


ABRASION is an operation in which abrasive gear-like tools are used to improve tooth form by removing burrs, nicks and projections. Unlike grinding or lapping methods, surface speed of the abrasive wheel is about one-eighth the speed of grinding. Virtually no heat is generated.



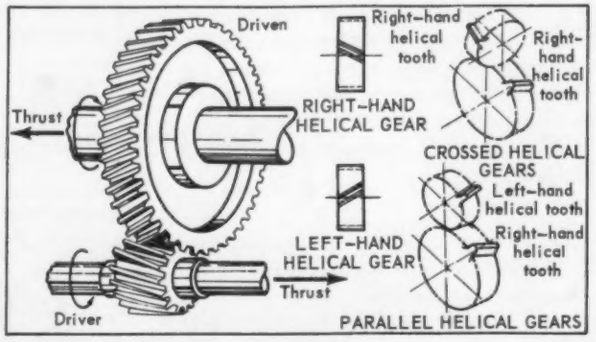
Gear Types

SPUR GEARS are cylindrical in form and operate on parallel axes. Teeth are straight and parallel to the axis.

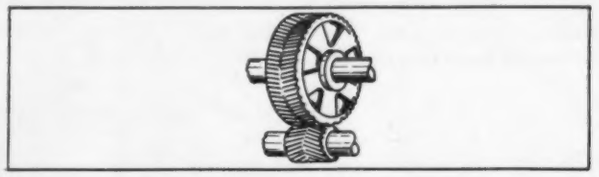


Gearing Nomenclature (Cont'd)

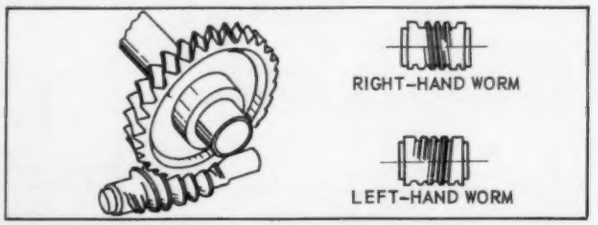
HELICAL GEARS are cylindrical in form and have helical teeth. On right-hand helical gears, teeth twist clockwise. On left-hand helical gears, teeth twist counter-clockwise. PARALLEL HELICAL gears operate on parallel axes and helices are of opposite hand. CROSSED HELICAL gears operate on crossed axes and may have teeth of the same or opposite hand. The term "crossed helical gears" has superseded the previous term "spiral gears".



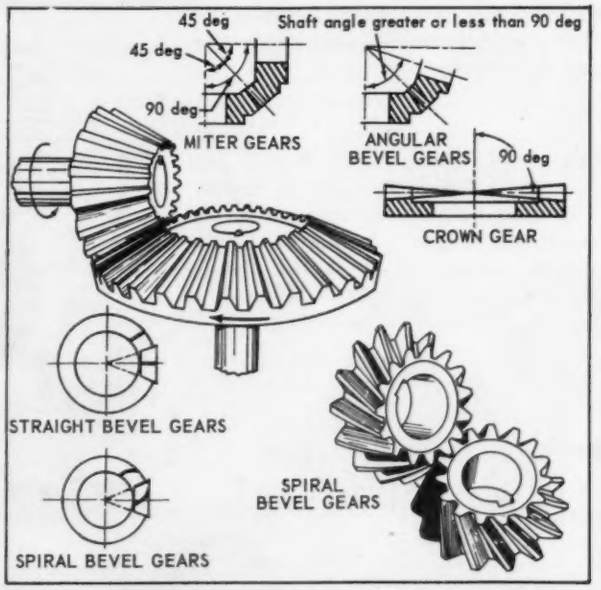
HERRINGBONE GEARS also are called double helical gears. They are generally cut without a groove separating the two rows of teeth.



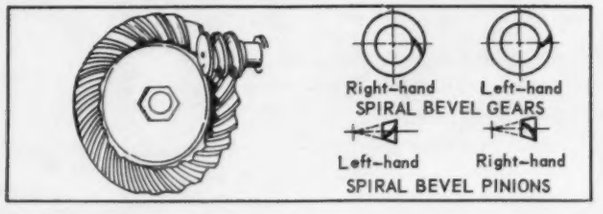
WORMGEARING includes worms and their mating gears. Axes are usually at right angles. As the worm turns, an endless procession of rack teeth moves against the teeth of the gear. A wormgear is the mate to a worm.



BEVEL GEARS are conical in form and operate on intersecting axes, usually at right angles. They can be used to transmit power from one shaft to another at right angles, and if the ratio is 1:1, they are often called "miter gears". When they are transmitting power through shafts not at right angles, they are called "angular bevel gears". CROWN gears are bevel gears with plane pitch surfaces. A crown gear corresponds to the rack in spur gearing. STRAIGHT BEVEL gears have straight teeth elements which, if extended, would pass through the point of intersection of their axes. SPIRAL BEVEL gears have teeth that are curved and oblique. Teeth are cut at such an angle that one end of each tooth enters mesh before the other end of the preceding tooth has disengaged.



HYPOID GEARS are similar in general form to bevel gears, but operate on non-intersecting axes. Nearly all hypoid gears have spiral teeth that are curved and oblique. Axes may be at any angle.



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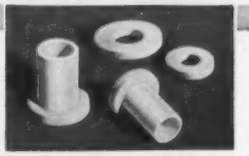

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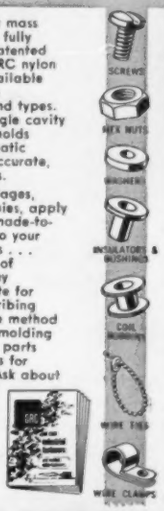

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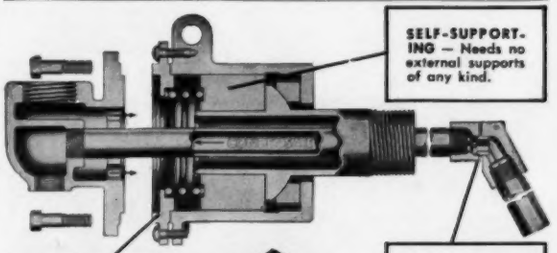
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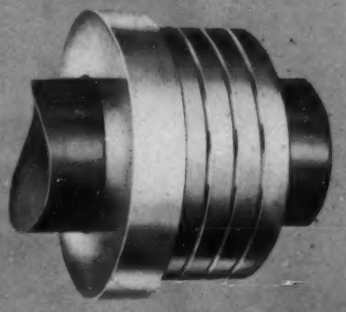

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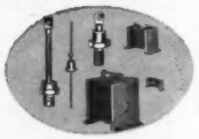
Silicon & Selenium Rectifiers

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Gearing Nomenclature (Cont'd)

CLEARANCE is the amount by which the dedendum in a given gear exceeds the addendum of its mating gear.

WORKING DEPTH is the total depth of a tooth space, equal to addendum plus dedendum and also to working depth plus clearance.

BACKLASH is the amount by which the width of a tooth space exceeds the thickness of the engaging tooth on the pitch circles.

CONE DISTANCE in a bevel gear is the general term for the distance along an element of the pitch cone from the apex to any given position in the teeth.

LENGTH OF ACTION is the distance on an involute line of action through which the point of contact moves during the action of the tooth profile.

PRESSURE ANGLE is the angle between a tooth profile and the line normal to a pitch surface, usually at the pitch point of the profile. Pressure angle also is used in the description and specification of the tools used to cut and generate gear teeth. Pressure angles most commonly used are 14½ or 20 deg.

HELIX ANGLE is the angle between any helix and an element of its cylinder. In helical gears and worms, it is at the pitch diameter unless otherwise specified.

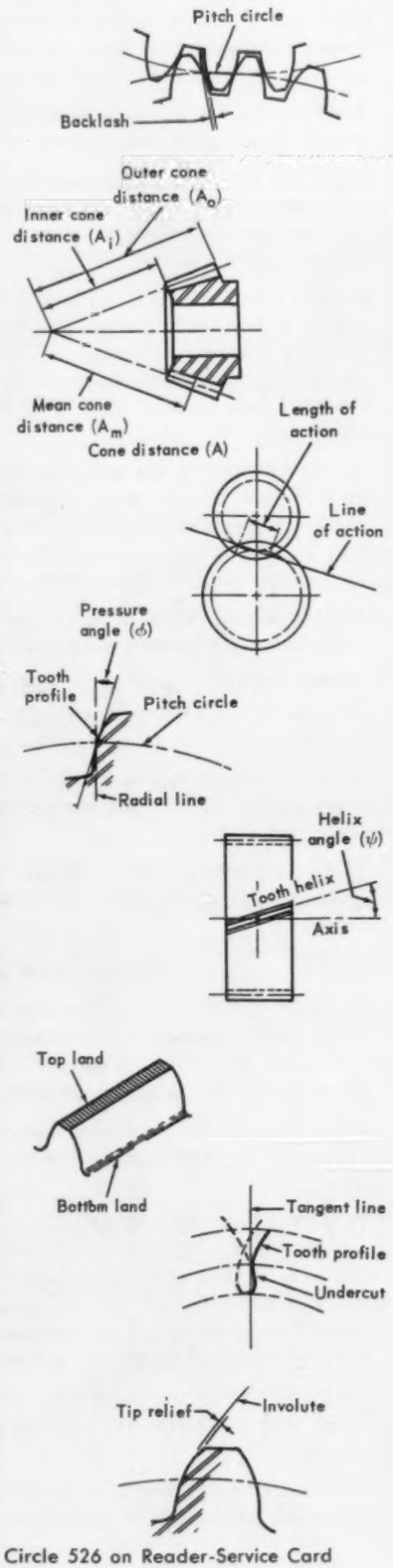
BOTTOM LAND is the surface at the bottom of a tooth space adjoining the fillet.

TOP LAND is the surface of the top of a tooth.

UNDERCUT is a condition in generated gear teeth in which any part of the fillet curve lies inside a line drawn tangent to the working profile at its lowest point. Undercut may be deliberately introduced to facilitate finishing operations.

CONTACT RATIO is the ratio of the arc of action to the circular pitch and sometimes is thought of as an average number of teeth in contact. For involute gears the contact ratio is obtained most directly as the ratio of the length of action to the base pitch.

TIP RELIEF is an arbitrary modification of a tooth profile whereby a small amount of material is removed near the tip of the gear tooth.



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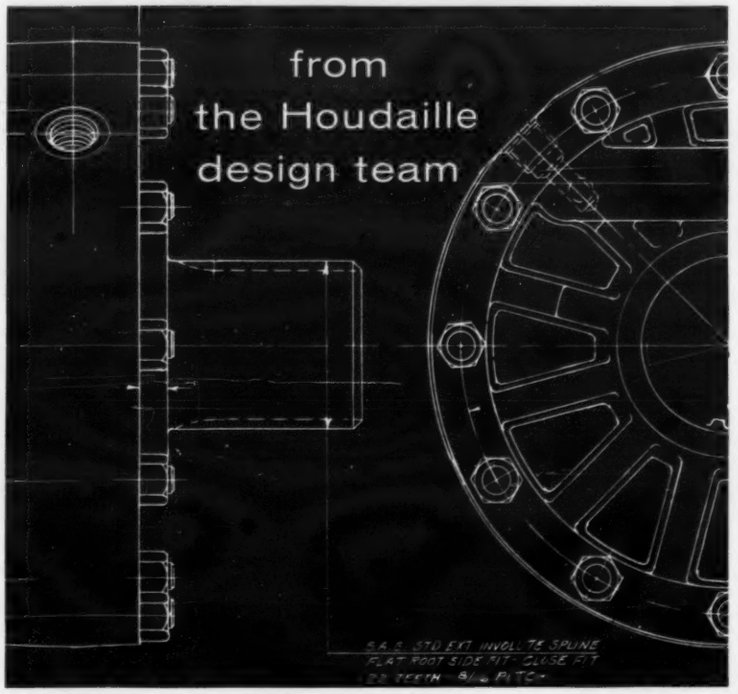
NEW



SIMPLEST HYDRAULIC ROTARY ACTUATOR A BACKHOE EVER HAD

Objective: to design a hydraulic rotary actuator that would give rugged service when used to control horizontal positioning on a backhoe boom. Like all Houdaille designs, this must incorporate top quality construction and high operating efficiency. Operating at 2250 p.s.i. the unit has a torque of 68,500 inch pounds with an angular travel of 220°.

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tells why tOtal 2 solves all

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the newly designed die-formed ring in a variety of materials and finishes.

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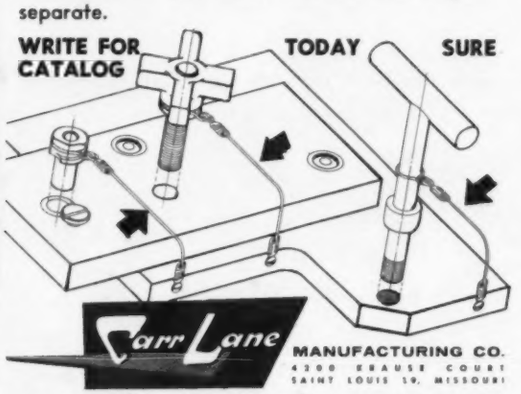

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International Standard Prefixes

Conversion Table

Paul Gheorghiu, Systems Engineer, Transitron Electronic Corp., Wakefield, Mass.

The accompanying table of International Standard Prefixes may be used to indicate decimal point movement and conversion of units.

Example 1:

Convert 10 microns to millimeters.

Solution:

Enter table at Micro in left-hand column, projecting horizontally to vertical Milli column. Move decimal point to left (direction of arrow) three figures. Ten microns equal 0.01 millimeter.

Example 2:

Convert 2 teraohms to megohms.

Solution:

Entering left-hand column at Tera, project to Mega column and note six. Two teraohms equal 2,000,000 megohms.

GIVEN	TO OBTAIN													
	Symbol	Tera	Giga	Mega	Kilo	Hecto	Deka	UNITY	Deci	Centi	Milli	Micro	Nano	Pico
Tera	T		3	6	9	10	11	12	13	14	15	18	21	24
Giga	G	3		3	6	7	8	9	10	11	12	15	18	21
Mega	M	6	3		3	4	5	6	7	8	9	12	15	18
Kilo	K	9	6	3		1	2	3	4	5	6	9	12	15
Hecto	h	10	7	4	1		1	2	3	4	5	8	11	14
Deka	dk	11	8	5	2	1		1	2	3	4	7	10	13
UNITY		12	9	6	3	2	1		1	2	3	6	9	12
Deci	d	13	10	7	4	3	2	1		1	2	5	8	11
Centi	c	14	11	8	5	4	3	2	1		1	4	7	10
Milli	m	15	12	9	6	5	4	3	2	1		3	6	9
Micro	μ	18	15	12	9	8	7	6	5	4	3		3	6
Nano	n	21	18	15	12	11	10	9	8	7	6	3		3
Pico	p	24	21	18	15	14	13	12	11	10	9	6	3	

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NEW LITERATURE

Semiconductor Cooling **451**

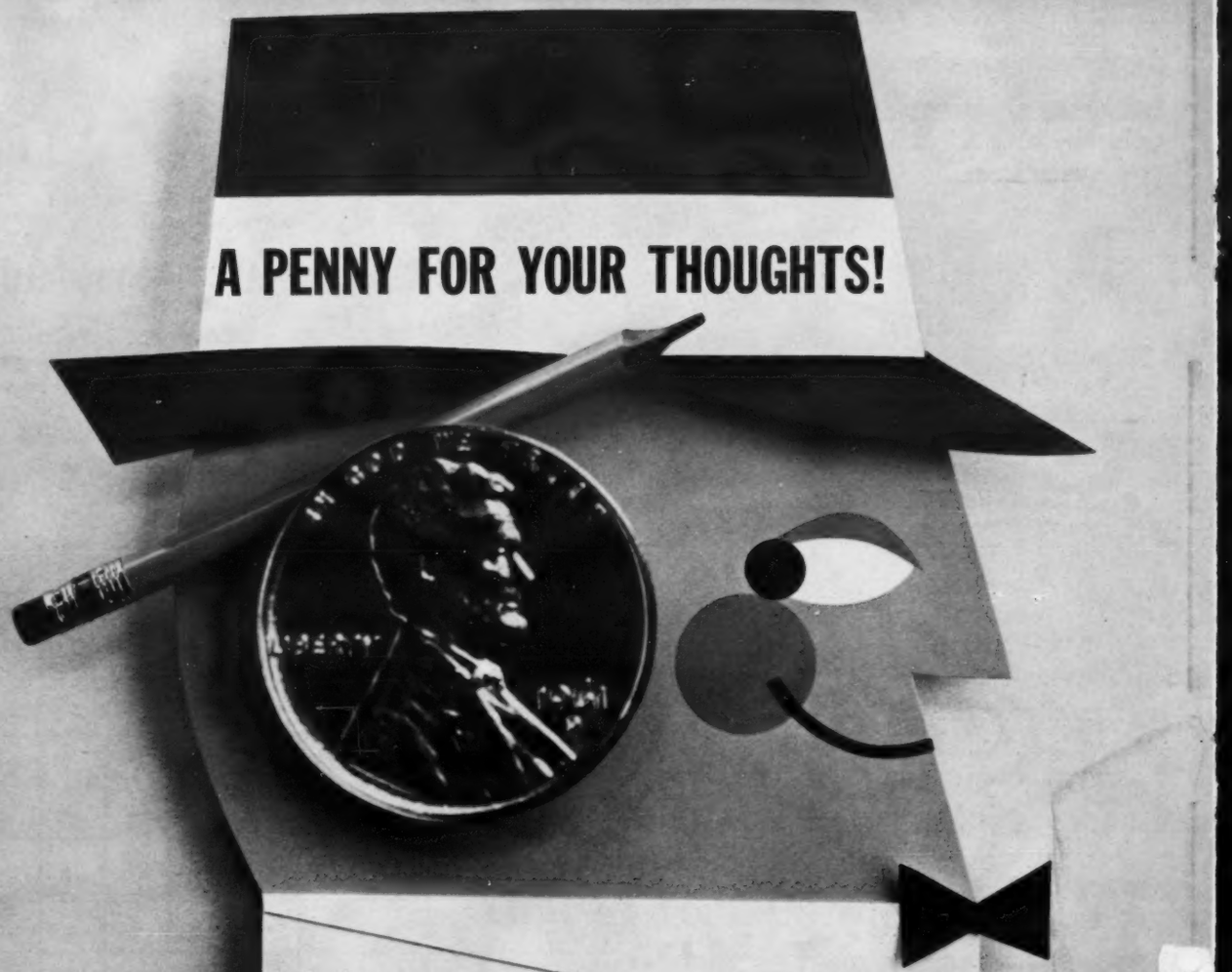
Outlines in detail the theory, as well as practical techniques, for temperature, power and air-flow measurement. Sections of the handbook cover fundamentals of heat transfer as applied to semiconductor cooling; temperature measurement techniques; power measurement techniques; air-flow measurement techniques; recommended rating procedures, and natural versus forced convection. Delta-T Semiconductor Cooling Div., Wakefield Engineering, Inc., Wakefield, Mass.

Vacuum Pump Slide Rule **452**

Set the slide rule at required air flow in cfm at zero psig, or zero inches Hg from atmosphere. This automatically selects the pump models required. After pump selections are made, set arrow on other side of slidechart at models selected to obtain airflow data and horsepower requirements as well as top recommended vacuum or pressure. Air flow characteristics given cover the 0 to 28 inch Hg vacuum or 0 to 30 psig pressure range. Gast Mfg. Corp., 2309 Fair Ave., Benton Harbor, Mich.

Specialty Fasteners **453**

Complete data on a wide variety of specialty fasteners include sizes, dimensions and installation information. Handbook No. 11, 56 pages, covers blind rivets, 1/4-turn fasteners, retractable screw fasteners, quick-opening screw fasteners, adjustable pawl fasteners, door and panel latches, threaded inserts, door retaining springs and fasteners for light fixtures. Tables of weights, decimal equivalents of drill sizes, machine screws—tap drill and clearance drill sizes, and standard gages are provided. Southco Div., South Chester Corp., Lester, Pa.



Design an aluminum extrusion, win $2500, $1000 or one of five $100 awards.

SOME WORDS OF ENCOURAGEMENT

It makes no difference whether your design idea is only now budding in your imagination, nurtured on your drawing board . . . accepted, rejected or utilized by your company. All designs using aluminum extrusions are welcome.

Whatever you're designing now, complete product or component part . . . try redesigning it using aluminum extrusions. Maybe a sticky design problem can be solved by developing a never-before-extruded shape that will take the place of a machined, formed or welded assembly, or one that, when sawed into sections, will reduce machining cost . . . or provide other product benefits.

First Place Winner Will Receive $2500. Runner-Up Will Win $1000. And Five Third Place Entries Take $100. each. All Entrants Receive a Bright, New Penny!

THE JUDGES AND HOW THEY CAN HELP YOU WIN

The top twelve designs selected by Kaiser Aluminum will then be finally judged by executives of the Independent Extruders listed on the opposite page. Your entry will be judged on the basis of originality of concept, product improvements, production cost and time savings, and other resultant or projected advantages that aluminum extrusions make possible.

For a better idea of the vast applications for extrusions and for any technical assistance you may need, contact the Independent Extruder nearest you (see list on opposite page). You can call on his and Kaiser Aluminum's vast extrusion experience to give you expert technical guidance in selection of alloys, tolerances, mechanical properties, tooling and extrusion costs.

NEW DEADLINE SEPT. 30, 1961

A PENNY FOR YOUR THOUGHTS!

ENTRY BLANK

1. One $2500, one $1000 and five $100 awards will be made by Kaiser Aluminum & Chemical Corporation for the extrusion designs submitted and judged to be the first, second and five other best designs submitted. Decision of the judges will be final.
2. All designs submitted must be postmarked before midnight A[redacted] September 30, 1961.
3. Each entry and its subject matter shall be the property of Kaiser Aluminum. Entrants accept these rules when submitting their entries, and agree that Kaiser Aluminum may use the entries in any manner without restriction and without payment or any other obligation to the entrant except to the extent set out in Paragraph 1 above.
4. Contest is open to all persons except employees and families of Kaiser Aluminum & Chemical Corporation, Kaiser Aluminum & Chemical Sales, Inc. and independent extruders.
5. No entry will be accepted unless accompanied by a signed contest entry blank, addressed to:

   PENNY FOR YOUR THOUGHTS CONTEST
   Kaiser Aluminum & Chemical Corporation
   Kaiser Center, Room 847, Oakland 12, California

Signature of Entrant_____

Date_____ **Company**_____

Title_____ **Address**_____

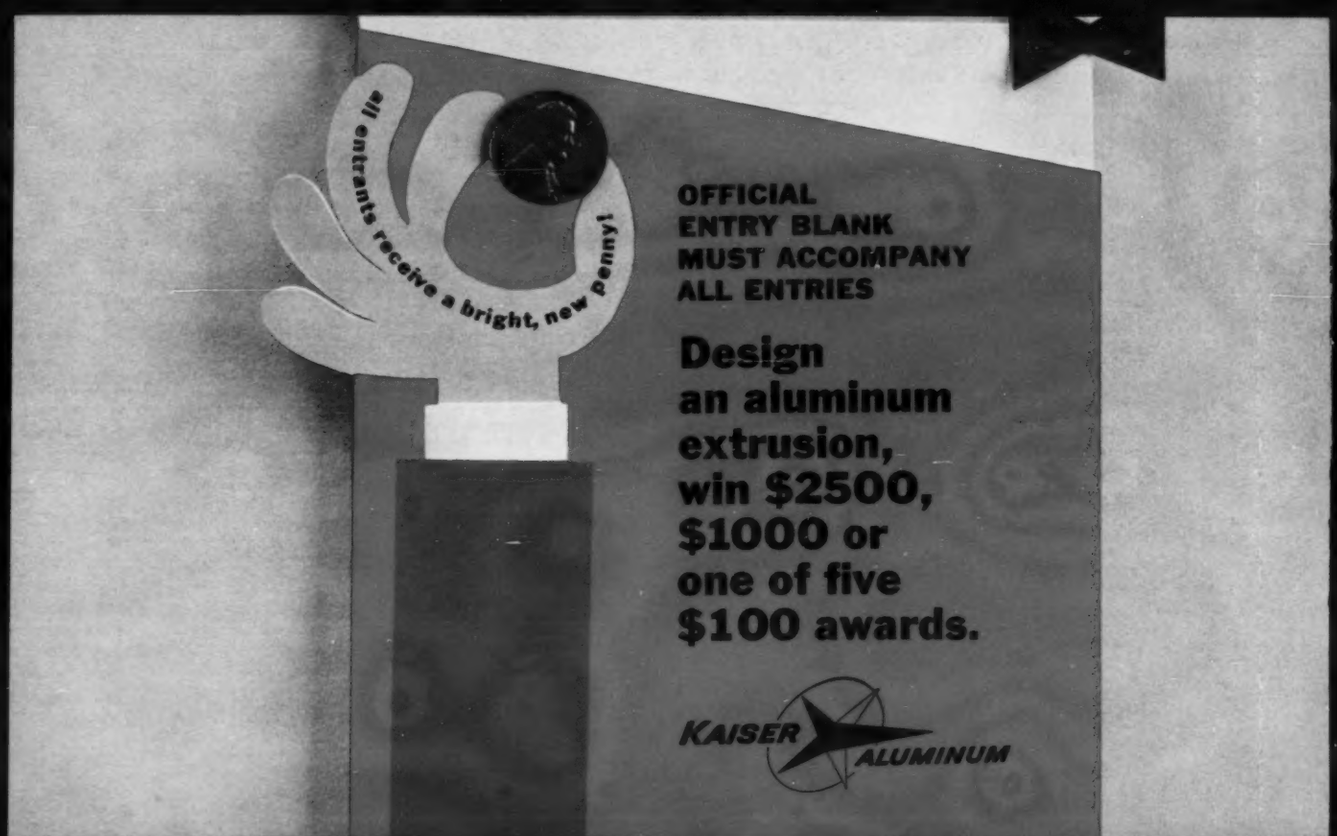
City_____ **Zone**____ **State**_____

Additional entry blanks are available from the independent extruder nearest you.

KAISER ALUMINUM

Kaiser Center, Oakland, California

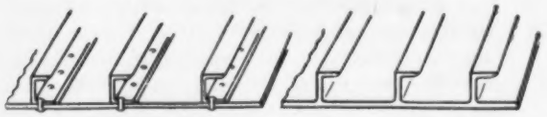
See HONG KONG and MAVERICK weekly, ABC-TV Network


all entrants receive a bright, new penny!
OFFICIAL
ENTRY BLANK
MUST ACCOMPANY
ALL ENTRIES
Design
an aluminum
extrusion,
win $2500,
$1000 or
one of five
$100 awards.
KAISER ALUMINUM

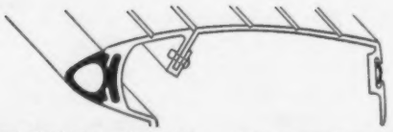
No Contest Is Complete Without Clues

To help you get started on your winning design . . . here are just a few examples of extrusions and the parts they replace.

BETTER HEAT TRANSFER . . . The extrusion process makes possible the integral shape shown at right, above. This design provides greater area for heat transfer and minimizes assembly costs.



LOWER WEIGHT, FASTER ASSEMBLY . . . Several different shapes can often be combined into a single extrusion. The integrally stiffened panel above, right, weighs less, reduces joining cost.



GREATER DESIGN FREEDOM . . . This gunwale provides structural strength as well as good appearance. Made as an extrusion, it provides for interlocking, decorative and utilitarian bumpers as well as color strips. No other process allows the styling and low upkeep possibilities found with Aluminum Extrusions. And extrusion dies are inexpensive compared with tooling costs for other types of fabrication. Fasteners are hidden and no welding is necessary.

LESS MACHINING . . . The low inertia hollow rotating member is manufactured from a close tolerance extrusion. It is sawed into sections from a continuous profile rather than from machined castings or bar stock. The extrusion process reduces expensive tooling, scrap and production time.

Now Start Thinking And Designing...It Could Mean Cash For You!

How To Submit Your Winning Entry.

1. All drawings and descriptions must be submitted on white paper no larger than 16″ x 20″ with the name of your extrusion design and your name and address typed or printed on the upper left corner of each page. Official entry blank must be included.
2. Each design submitted must clearly show the functional purpose of the extrusion.
3. Include a description of your design, its purpose and advantages and any comparisons between the new design and the product or component it might replace.
4. Photographs of existing components, products or your new design may be submitted along with your entry.
5. Contest entries must be postmarked before midnight, September 30, 1961. Winners will be notified by mail before November, 1961.

CONTACT THE INDEPENDENT EXTRUDER NEAREST YOU

for expert advice on all extrusion problems or for additional entry blanks.

ARKANSAS

Southern Extrusions, Inc.	Magnolia	CE 4-4260

CALIFORNIA

The Aluminum Extrusion Co.	Los Angeles	CL 5-1511
American International	San Jose	CY 8-1606
B & T Metals Co.	Los Angeles	RA 3-4501
Jotaco Extrusions, Inc.	Orange	KE 2-6331
Kawneer Company	Richmond	BE 2-1821
Michael Flynn Mfg. Co.	City of Industry	CU 3-6407
Pacific Extrusion, Inc.	Watsonville	PA 4-2244
Pax Metal Corp.	Van Nuys	TR 3-2720
Texas Aluminum	Mojave	VA 4-4021

FLORIDA

American International Aluminum Corp.	Miami	NE 4-8591
General Aluminum Fabricators	Miami	TU 7-8231
Miami Extruders, Inc.	Miami	OX 1-8900
Regal Extrusion Corp.	Miami	NE 3-8128
Ware Laboratories, Inc.	Miami	NE 4-8511

GEORGIA

Loxcreen Co., Inc.	Chamblee	GL 7-6394

ILLINOIS

Kawneer Company	St. Charles (Chicago)	MA 6-2287
Kinkead Industries, Inc.	Chicago	IN 3-7800
Mala Extrusions, Inc.	Rock Island	788-9321
Precision Extrusions, Inc.	Bensenville (Chicago)	NA 5-4600

INDIANA

Greater Louisville Industries, Inc.	Jeffersonville	BU 2-4341
Mainline Extrusions, Inc.	South Bend	AT 8-9244
Wells Aluminum Corp.	North Liberty	OL 6-8111

IOWA

Titus Metals Corp.	Waterloo	AD 4-1771

MASSACHUSETTS

Northeast Aluminum, Inc.	Lawrence	MU 3-2718
Royce Aluminum, Inc.	Taunton	VA 4-8631
Trim Alloys, Inc.	Boston	AN 8-5200

MICHIGAN

Aluminum Extrusions, Inc.	Charlotte	543-2010
Brazeway, Inc.	Adrian	CO 5-2121
Detroit Gasket & Mfg. Co.	Detroit	KE 1-3400
Ferguson Extrusions, Inc.	Detroit	TE 4-5081
Light Metals Corp.	Grand Rapids	RI 2-3481
Midwest Aluminum Corp.	Kalamazoo	FI 5-8155
North American Extrusions Corp.	Kalamazoo	FI 5-8610
Purpose Extruded Aluminum	Hudson	HI 8-2551
Quality Aluminum Products Co.	Coldwater	BR 8-2381
Rogers Industries	Detroit	VE 8-7500
Valley Metals Products Co.	Plainwell	MU 5-8711

MISSOURI

Hazelwood Engineering & Equipment Co.	Hazelwood (St. Louis)	PE 1-2274

NEW JERSEY

Corson Industries	Delair	NO 2-5500
Mideast Aluminum Corp.	Dayton	DA 9-8113
New Jersey Aluminum Extrusions	N. Brunswick	CH 9-6867
Warner Mfg. Corporation	Bloomfield	PI 8-5000

NEW YORK

Alan Scott Aluminum	Westbury	ED 4-1800
Aywon Wire & Metal Corp.	Brooklyn	TE 9-1000
Badger Aluminum Extrusions	Brooklyn	NI 9-6400
Empire Extrusions Corp.	Garden City Park, L. I.	PI 1-6600
Jarl Extrusions, Inc.	E. Rochester	LU 6-2660
Jasco Aluminum Products Div. of Irving Air Chute Co.	New Hyde Park	FI 3-4306
Jerex Corporation	Amityville	MY 1-7270

NORTH CAROLINA

Carolina Aluminum Co.	Winton	358-4111

OHIO

Aisco, Inc.	Akron	BL 3-7701
B & T Metals Co.	Columbus	CA 8-5411
Calex Corp.	Campbell	PL 5-9679
General Extrusions, Inc.	Youngstown	ST 8-9681
Magnode Products, Inc.	Trenton	YU 8-6331
National Extrusions & Mfg. Co.	Bellefontaine	LY 2-9010
F. A. Pilgrim Co., Inc.	Youngstown	ST 8-4077
Saramar Aluminum Co.	Youngstown	SW 9-9741
F. E. Schumacher Co., Inc.	Hartville	TR 7-9307
Weather-Seal, Inc.	Barberton	SH 5-2114
Youngstown Mfg., Inc.	Youngstown	RI 3-1161

OKLAHOMA

Macklanburg-Duncan Co.	Oklahoma City	JA 8-4411

PENNSYLVANIA

Airmaster	Philadelphia	BA 3-7700
Michael Flynn Mfg. Co.	Philadelphia	FI 2-5500
Penn Brass	Erie	TE 8-1931
Pittsburgh Aluminum Alloys Co.	Pittsburgh	BR 1-4744
R. D. Werner Co., Inc.	Greenville	JU 8-8600

SOUTH CAROLINA

Extruded Aluminum Co., Inc.	Summerville	TR 3-2381

TEXAS

Bauer Aluminum Co.	Dallas	AD 5-2357
May, Inc.	Houston	MO 7-1780
Texas Aluminum Co., Inc.	Dallas	RI 1-3361

KAISER ALUMINUM *

*T.M. Kaiser Aluminum & Chemical Corporation

"New leadership in the world of aluminum"

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Current History Documents 454

This 36-page book consists of three documents: "N. S. Khrushchev's Moscow Radio and Television Speech on his Meeting and Talks with John F. Kennedy in Vienna, June 3 and 4, 1961"; "Memorandum on the Questions of Ending Atomic and Hydrogen Weapons Tests", and "Memorandum on a Treaty with Germany". This translation was prepared in response to the demand for information and source material on Soviet developments. The memoranda are translations of material presented to President Kennedy by Chairman Khrushchev at their meeting in Vienna, June 3 and 4. Crosscurrents Press, Inc., 156 Fifth Ave., New York 10, N. Y.

Stereo/FM Broadcasting 455

"Factual Answers to Your Questions about Stereo/FM Broadcasting" also tells how stereophonic/FM broadcasting came into being. Some of the questions answered in the 16-page pocket-sized edition are "What is stereophonic sound reproduction?"; "How is stereo/FM different from stereo radio broadcasts that are on the air now?"; "Will my present monophonic FM set become obsolete?"; "What about the finally adopted stereo/FM standards?"; "How much will stereo/FM radios cost?"; "What about adapters? Can I convert my present radio set to stereo?", "What does the customer do, if he wants to buy a stereo phonograph now, but be prepared for stereo/FM later on when stations in his area begin stereo broadcasts?". Zenith Sales Corp., 6001 Dickens Ave., Chicago 39, Ill.

Pumps, Cylinders and Valves 456

A hydraulic pump which provides pressures of 3000 to 5000 psi is illustrated. Catalog 21, 74 pages, shows schematically a reversible closed-center pump unit with motor running forward and with motor shut off. Single direction pumps, pumps with pressure switches and relief valves, and hand pumps are included. Five pressure curves are provided. Standard and heavy-duty pressure switches in single and duplex models are illustrated, and dimensional and wiring information is given. Hydraulic and air cylinders with from 1/2 to 4 inch bores are detailed. Accessories illustrated include external relief valves, metering and shutoff valves, check valves, hydraulic tube fittings, male and female connectors, steel pipe fittings, adapters, seals, cutters and taps. Oil-Dyne, Inc., 2115 W. Marquette Rd., Chicago 36, Ill.

A Chemically Fueled Propulsion System for Deep Submergence

H. L. Howell, Avien, Inc., Woodside, N. Y.

This paper presents a type of propulsion system which is capable of efficient operation for extended periods at the ocean bottom. Potential applications include decoys, targets, surveillance drones, torpedoes, self-propelled mines, manned research and military craft, remote mechanical manipulators, power packs for underwater construction and salvage.

Types of Powerplant

Energy sources suitable for propelling the smaller undersea devices fall into one of two general categories:

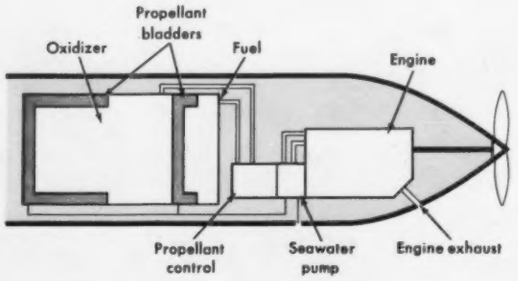
1. The prestored system in which the unit is "wound-up" prior to launch.
2. The latent energy system in which chemical energy is released through changes in molecular structure.

Two examples of the first category are the mechanical spring and compressed gas which depend upon material stress for energy storage.

Chemicals can be used to generate electricity directly for conversion to mechanical power by means of electrical motors.

FAIRCHILD X-1 SUBMARINE - IN WATER Fig. 1

Chemical energy also can be released through the catalytic action of secondary materials, or by a localized heat source. The resulting exothermic reaction produces a high-temperature gas suitable for impelling a turbine or a reciprocating prime mover. Fig. 1 shows the hydrogen peroxide-powered Fairchild X-1 sub.



CHEMICALLY FUELED PROPULSION SYSTEM DIRECT TO SEAWATER EXHAUST Fig. 2

Effect of Depth On Thermal-Engine Performance

A thermal-engine, liquid-propellant-type propulsion system is shown schematically in Fig. 2. The propellants are contained in bladders located in separate tanks and are displaced by seawater. In addition to providing displacement pressure, the seawater serves to maintain near constant buoyancy of the vehicle. The propellants are metered in the proper volume and ratio by a propellant control prior to combustion in an external chamber or within the engine cylinder. After expansion in the prime mover, the propellant gases are exhausted through the skin of the vehicle directly to the ocean. The thermal-engine data shown thus far have been derived for such a system.

The effect of depth on the performance of the system just described is to decrease the working-pressure ratio. In order to hold constant horsepower in such a situation, the inlet pressure or average cylinder pressure must be increased.

Methods of Reducing Depth Effect On Thermal-Engine Performance

There are two basic ways to reduce the effect of depth pressure on performance of a thermal-engine cycle. The closed-loop system is one method in which the working cycle is isolated completely from the depth environment. This system requires an efficient, compact, high-temperature, high-pressure boiler and condenser. Control of both the working fluid loop and the propellants must be provided for. Propellant exhaust wake and noise also may be a problem in certain applications.

A second method consists of holding engine exhaust pressure at or near the sea level value by pumping the exhaust up to depth pressure before discharge into the ocean. Exhaust pumping work is not as large as might be expected, particularly if the following techniques are utilized.

1. Cooling of exhaust and condensation of condensables prior to pumping.
2. Employment of propellants having a large percentage of condensables in the exhaust products.
3. Intercooling between stages of noncondensable gas compression.
4. Storage of the treated exhaust products in the evacuated sections of the propellant tanks.

The high efficiency of the pumping part of the cycle is illustrated by Fig. 3 which plots pumping work for CO_2 gas compression.

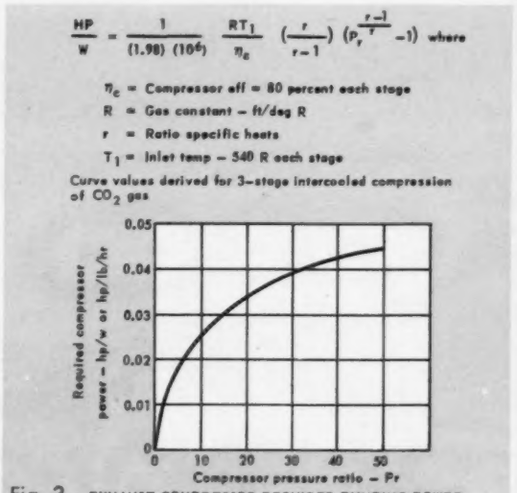


Fig. 3 EXHAUST COMPRESSOR REQUIRED PUMPING POWER

Exhaust Pumping System Design

The preceding analysis indicates the practicality of the exhaust pumping approach. A specific system design for about 20-hp output is analyzed in more detail as follows:

The system incorporates a rod-crank reciprocating prime mover operating with 90 percent H_2O_2 and diesel fuel, a reciprocating CO_2 compressor, two condensers, a two-stage water condensate pump and a propellant control. The arrangement of these com-

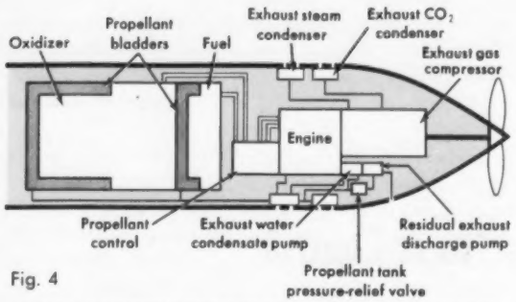


Fig. 4

CHEMICALLY FUELED PROPULSION SYSTEM EXHAUST GAS PUMPING

ponents is shown on Fig. 4.

The propellants pass from pressurized tanks into the propellant control, and from there into the prime mover where they expand to produce power. The prime mover exhausts into a condenser which is shown as an integral part of the vehicle hull. The water is condensed out of the exhaust gas and is pumped to a storage area behind the propellant bladders. The cooled CO_2 gases, taken out at the top of the condenser, pass into the exhaust gas compressor inlet. After reaching a pressure of about 1000 psi, depending upon seawater temperature, the gas passes through a CO_2 condenser. All of the liquid CO_2 and the residual O_2 and CO pass back to the storage area behind the propellant.

Since the density of the compressed exhaust is somewhat less than propellant density, not all of the exhaust can be stored in the evacuated sections of the propellant tanks.

The surplus is relieved to the ocean by pumping a portion of the water condensate to depth pressure. In certain military applications where complete wakelessness and minimum noise are required, additional space can be made available behind the propellants so that no exhaust products at all need be pumped overboard.

The propellant tanks are aluminum and could be designed to serve also as shipping and storage containers to eliminate tank-to-tank propellant transfer. The tanks are fitted with bladders made of "Teflon," "Viton A" or other compatible, flexible plastic material.

Propellant is controlled by means of a speed governor which positions the rack of a dual-propellant injection and metering pump. The metering pump is similar to that used in diesel-engine practice, with the addition of features which eliminate the difficulty of handling a corrosive fluid in a reciprocating piston, and which reduce the possibility of accidental mixing of oxidizer and fuel.

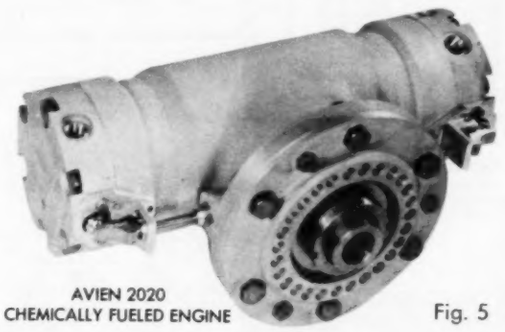
The exhaust-gas compressor employs two reciprocating stages to compress 30 psia gas to 1000 psia. The required capacity is 0.18 cfm per engine horsepower, a displacement of less than 1/6 of that of the engine, which makes the unit considerably smaller than the prime mover.

The condensate water pump consists of two stages with pressure regulation between the two. The first stage operates at 1000-psia back pressure and delivers water condensate partly to the storage area and partly to the pump second stage. The second stage flow prevents excessive pressure buildup in the storage area by pumping the excess volume from 1000 psia overboard to depth pressure.

Control of both exhaust-water condensate level and propellant-tank pressure is accomplished either by intermittent operation of fixed-displacement, electrically driven pumps, or by flow control of variable-displacement, engine-driven pumps. The engine-driven exhaust-gas compressor requires no control. Minor variations in compressor-inlet pressure are tolerated so that variations in exhaust mass flow rate can be digested by the fixed-displacement compressor. Exhaust-system control is therefore simple and independent of the propellant control.

Fig. 5 shows an engine which has been designed specifically for undersea applications and which is well suited to the prime mover requirements of the deep submergence, exhaust pumping system. The unit was designed to produce up to 30 hp at 3000 rpm. Two firing chambers with an unusual piston and crank arrangement provide a compact and lightweight configuration. The maximum dimension is 11.7 inches and the weight, without accessories, is 17.3 lb.

The engine is designed for operation primarily with H_2O_2 and diesel fuel. However, modifications can be made to permit the use of other propellants. A total displacement of 20 cu in is ample for accurate metering and efficient internal combustion of propellants.



AVIEN 2020
CHEMICALLY FUELED ENGINE

Fig. 5

The simplicity of the drive system has resulted in a significant reduction in moving parts as compared with the conventional rod-crank arrangement.

The engine is designed to operate at an SEC of 7.0 lb/hr/shp at sea level in a direct exhaust system. In the deep submergence system, SEC would be 7.9 lb/hr/shp between sea level and 2300 ft, plus 0.8 percent for each additional 1000 ft in the case of partial overboard pumping.

Abstracted from technical paper SAE No. 349C; $1; to SAE members, $0.75. Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y.

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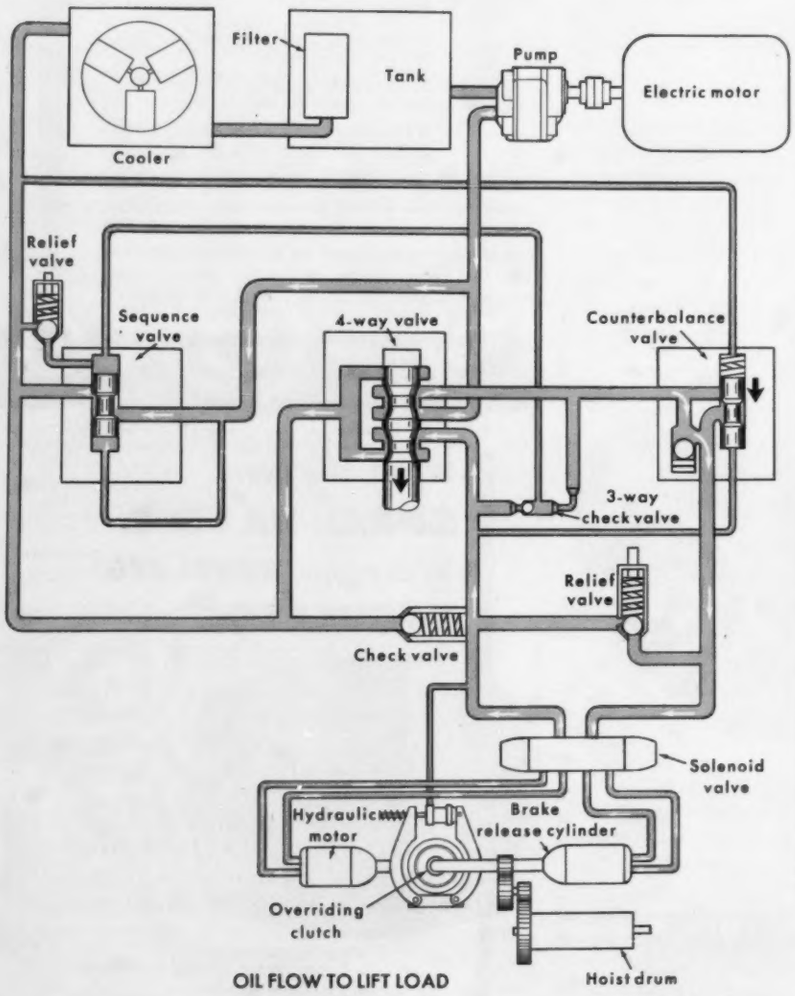
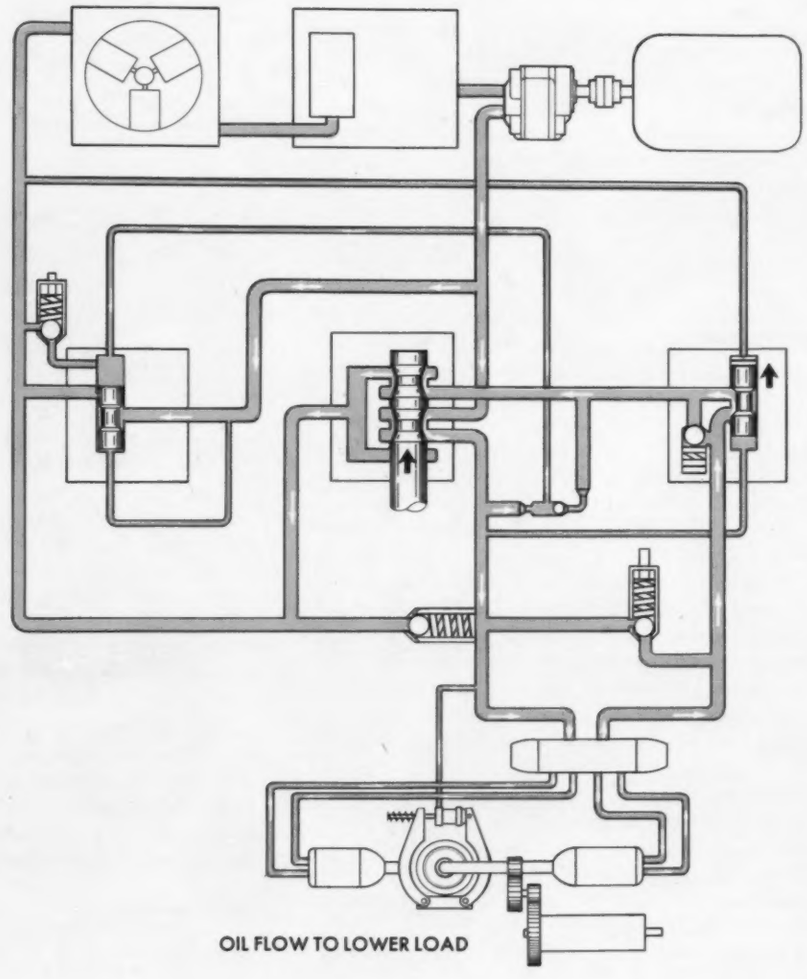
All-Hydraulic Crane Features Two-Speed Stepless Hoist Control

Lars G. Soderholm, Midwest Editor





Series-parallel fluid motor arrangement, flow control valve combination and aircraft cable cab-to-trolley link provide flexibility in a unique overhead crane design.

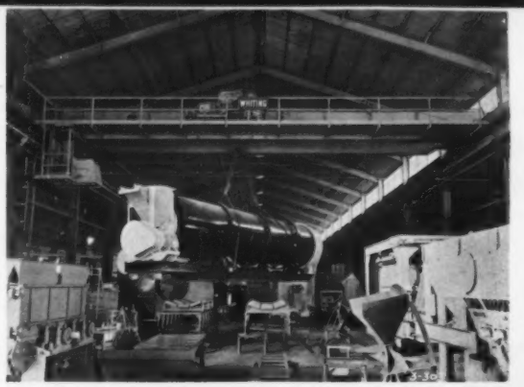
An electrohydraulic crane, using hydraulic circuits to control its bridge, trolley and hoist motions, shifts two hydraulic motors between series and parallel operations to provide two-speed stepless hook control. High speed is used for light loads and low speed for either heavy loads or precise positioning. Manifolded hydraulic valves in the hoist lift circuit form a flow-control device capable of delivering any required volume of oil to the hydraulic motors that drive the cable drum. Valve positions on the trolley, as it moves back and forth on the bridge, are set and held through a pretensioned aircraft cable linkage.

To overcome some of the difficulties of an all-electrical control system, the designers of this hydraulic crane chose to use a hydraulic approach to precision crane control. It was felt that a hydraulic system lent itself much better to speed control, and the system itself could dissipate energy in the form of heat to the fluid that had to be dissipated otherwise by the brake system.

To make a workable hydraulic hoist circuit, it was necessary to obtain a uniform lifting and lowering speed regardless of whether the crane was carrying a load or not. It was also necessary to take precautions so that the load would not be able to take over the circuit and run the fluid motors as pumps.

Control of lifting speed was obtained through a four-way valve and sequence valve combination that operate together as a flow control unit. When the four-way valve is opened, an orifice is created, diverting a certain portion of the total flow to the hydraulic motors while the rest passes through the sequence valve and to tank.

To keep the load from running the hydraulic motor during lowering, a counterbalance valve is used. If the load attempts to turn the fluid motors, the system pressure drops, causing the counterbalance valve spring to close the valve until pressure again is built up in the system.



A safety brake of the conventional type is provided on the input side of the double-reduction gear case. When lifting a load, the brake remains closed as the shaft turns freely through a one-way sprag-type clutch in the brake drum. When a load is lowered, a hydraulic cylinder releases the brake at a system pressure of about 200 psi. The counterbalance valve still maintains its hold on the load, however, until a pressure of about 300 psi is reached. The only function of the safety brake during normal operation is holding when the control valve is in its neutral position.

The electric motors, pumps, reservoir, cooler and valve manifold as well as the conventional hoist components all are mounted on the trolley which travels on rails across the crane bridge. The operator in his cab must be able to position the four-way valve on the trolley wherever the trolley may be.

This problem was solved by running an endless loop of small-diameter aircraft cable from one end of the bridge to the other and then down to a control handle in the operator's cab. The position of the control handle is translated into some angular displacement of a pivoted arm which is connected to the four-way valve.

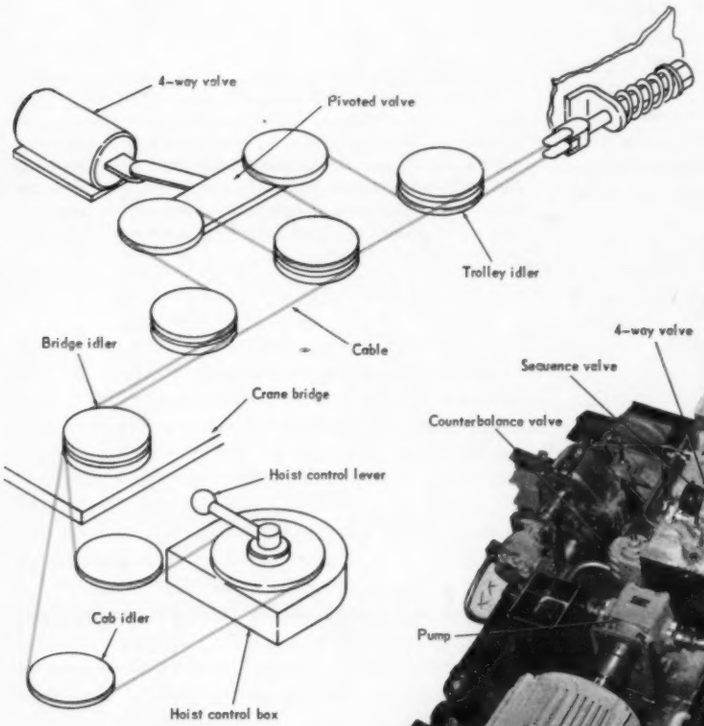
The crane hook upper-limit control is through a paddle which, through a linkage, pushes the spool of the four-way valve into its neutral position. The operator can resume control by putting his control handle in the down position.

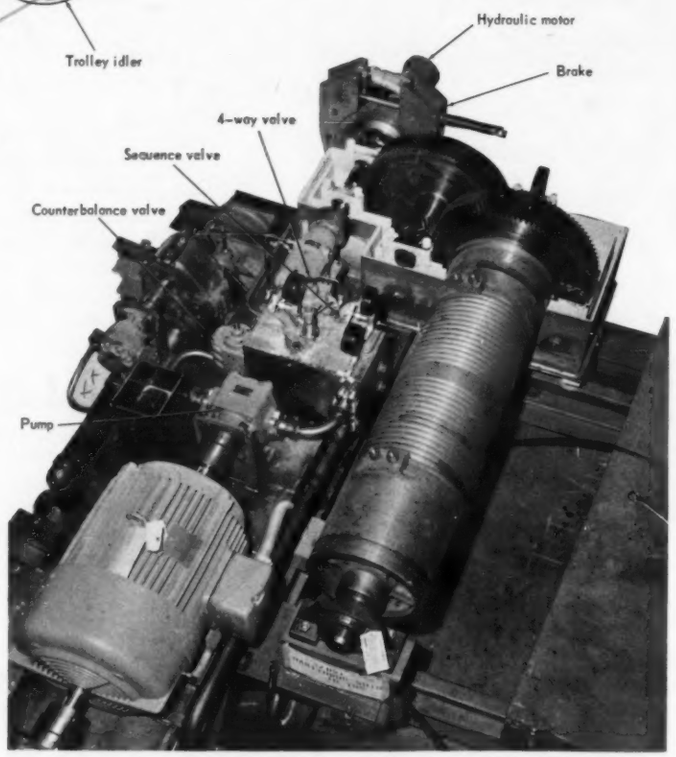
The trolley and bridge circuits are simple compared to the hoist circuit. All motions are controlled through a single open-center four-way valve.

The hydraulic control system permits extremely close and accurate control over the hook during the hoisting or lowering of loads. The system develops only enough pressure to follow the operator's control setting whether the hook is empty or loaded. The wide range of speeds is all stepless.

Electrical problems resulting from current surges during starting and reversing motors are avoided entirely since the squirrel-cage motors operating the pumps ordinarily are permitted to run constantly.

The hydroelectric crane was developed by the Whiting Corp., Harvey, Ill.





Mechanical Memory Board Simplifies Design and Operation of Typesetting System

E. J. Stefanides, Central States Editor

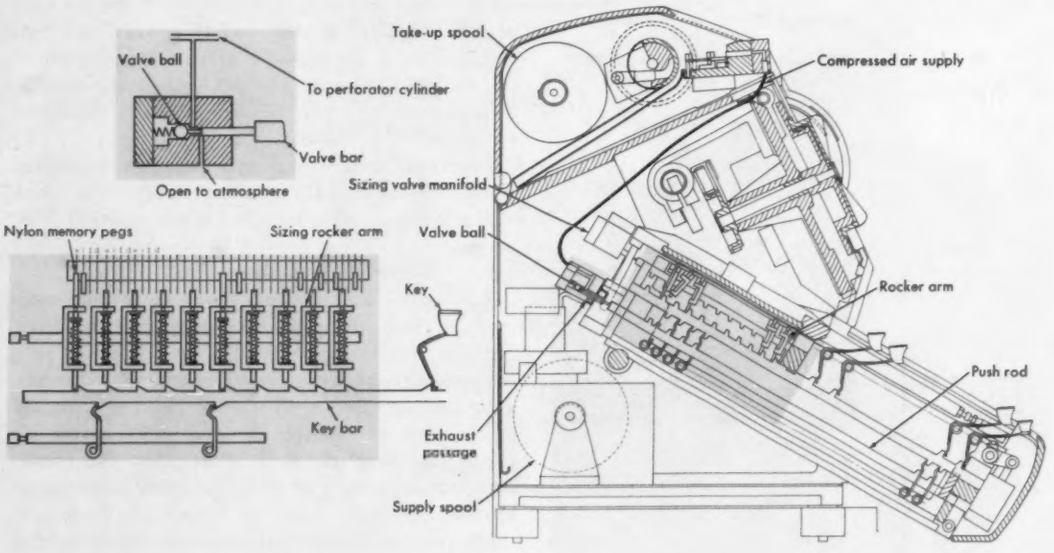
A mechanical, patchboard memory system is used in the latest Monotype equipment for mechanical typesetting. The memory system simplifies the equipment design, reduces its size and provides faster, easier operation.

In the Monotype system, a keyboard machine is used to pneumatically encode a series of perforations in a 4-inch-wide paper tape. The tape later is run through a typecaster which reads the perforations, selecting and casting the individual characters and automatically assembling them into finished galleys of justified lines.

On the typecaster, selection of the characters cast is accomplished by x-y positioning of a matrix case over the nozzle of a type-metal casting pump. The matrix case contains matrices, or type molds, for 324 characters, arranged in four quadrants of 81 characters each, each quadrant containing a complete font of type (type face alphabet). Normally the arrangement of characters within each quadrant is identical, however, the relative unit size of individual characters and spaces varies from font to font. Thus the encoded signal must define not only the character location and quadrant but also must define the characters' unit size (width).

A mechanical memory system called a Unit Size Control Plate controls the encoding of unit size (width) of the characters and allows a single keybutton layout to be used for all four quadrants. It consists of a cast aluminum plate having 40 holes for each keybutton. The sizing plate can be shifted to four different positions, each position corresponding to one of the quadrants from which the character can be selected. It thus provides 10 unique holes for each character in each quadrant. Nylon pegs are placed in two of these holes to define the unit size. The pegs depress pins in two of 10 rocker arms which run across the machine beneath the sizing plate, coupling valve bars to the keybar. When a key is depressed, the valve bars actuate valves to admit air to the selected perforating cylinders which encode the unit size. When the tape is run through a typecaster, these encoded perforations position wedges, which determine the mold size. The unit-size valves also admit air to the cylinders of a counting mechanism, which counts the unit size as the line is programmed. This mechanism gives the operator the necessary information for justifying. As he nears the end of the line, a calculator rotates telling him which justifying keys to depress in order to justify the line width. Depressing these keys encodes data which vary the basic size of a selected number of characters, or spaces, to justify (even out) the line.

KEYBOARD ENCODING is done by perforator controlled by keybutton layout and unit-size control plate. Each horizontal line of perforated tape represents one revolution of typecaster and contains data for one character, one space or part of justification signal. Justification data are encoded as end of line is reached. Encoded tape is run through typecaster without rewinding and justification signals are read before line character signals, allowing characters to be cast to exact width for justified line.

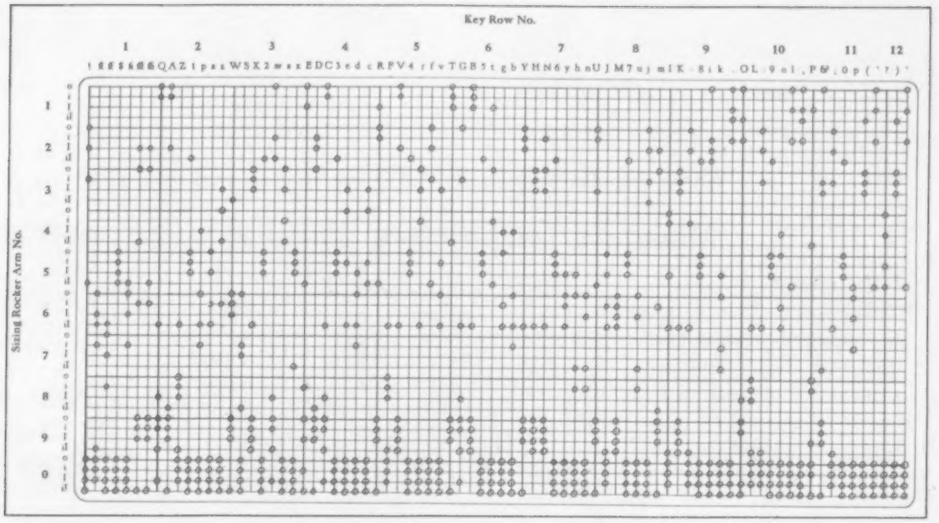


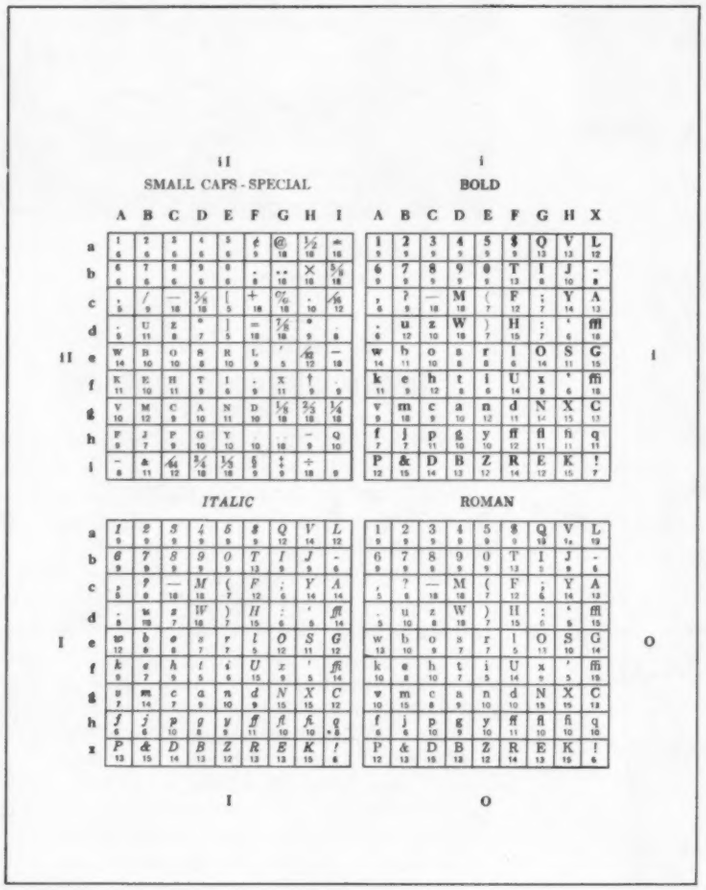
SECTION THROUGH KEYBOARD showing operation of peg memory system. Inserted peg depresses spring-loaded rocker-arm pin coupling rocker arm to keybar. When keybutton is struck, keybar actuates valves to supply air to miniature cylinder which perforates tape and to counter of justification calculator which counts unit size of characters. This provides operator with information for line justification. Simultaneously, keybar acuates valves controlling x and y coordinate-position punch cylinders.

A complete conversion of type-face can be made by simply inserting a new matrix case in the caster and a new unit-size control plate in the keyboard (or rearranging the old plate). Special characters for special jobs can be inserted in the matrix and the keyboard can be adapted by simply changing the two pegs of that character.

The new system, which comprises the simplified keyboard machine and a redesigned improved typecasting machine, has been designated the Monomatic. It was designed and is manufactured by the Lanston Monotype Co., a division of Lanston Industries, Inc., Philadelphia, Pa.

UNIT	ROCKER ARM NO.	UNIT	ROCKER ARM NO.
4	0.9	13	9.1
5	0.1	14	9.2
6	0.2	15	9.3
7	0.3	16	9.4
8	0.4	17	9.5
9	0.5	18	9.6
10	0.6	19	9.7
11	0.7	20	9.8
12	0.8		





BASIC PROBLEM AND SOLUTION. Same characters in different quadrants of matrix are selected by same keybutton, have same coordinates, but different unit sizes. Unit-size control plate shifts vertically to correspond to shift key depressed (quadrant signal). Rows of holes which are above rocker's arms during given shift are marked with same signal as quadrant. Location of two pegs in these holes determines signal for character unit size as shown in table. Ten rocker arms yield 17 unit sizes required (4 to 20 units).

DESIGN NEWS

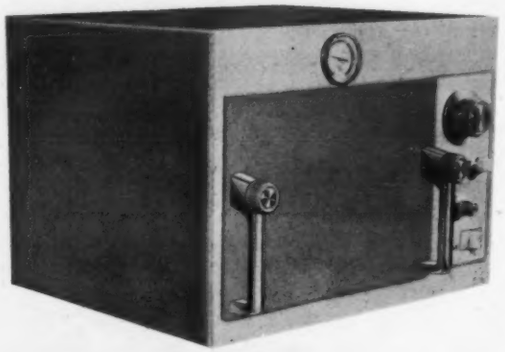
IDEAS IN THE NEWS

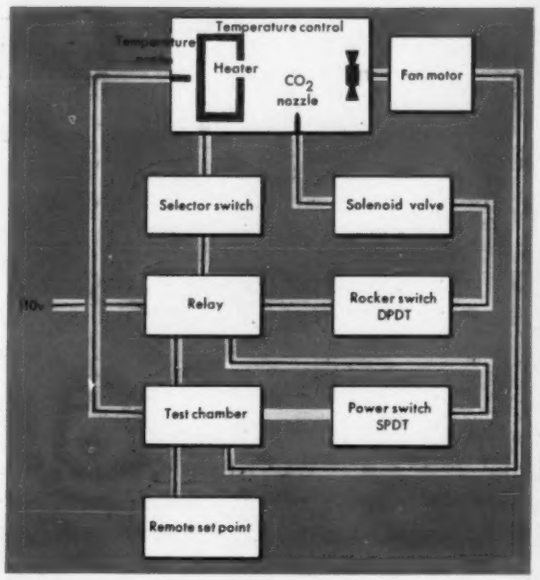
Miniature Temperature Chamber Improves Environmental Simulation

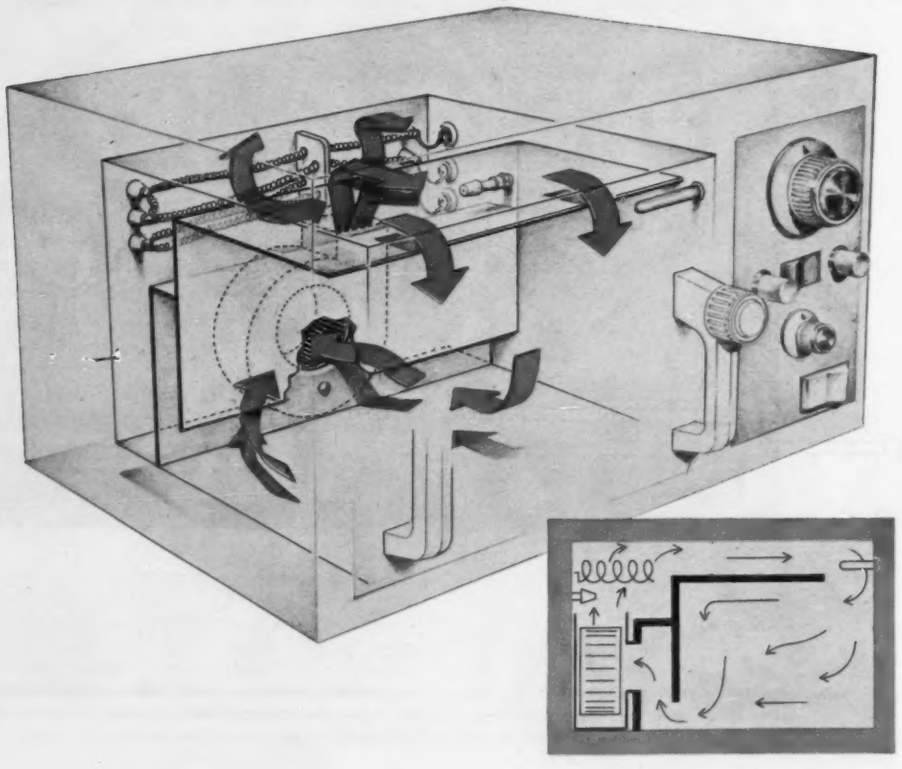
EL SEGUNDO, CALIF.–A miniature temperature chamber is designed to give ±0.5F temperature gradient for improved environmental simulation. Electronic controller with resistance bulb sensor anticipates temperature changes to reflect the small variation in temperature over the range of the unit. Temperature range is −100F to +500F.

A solenoid-operated injection valve meters liquid CO_2 for cold-temperature use. An electric heating element supplies heat for high-temperature use. An over-sized electric motor turns an air impeller to move air through the overhead duct and return the air through the chamber.

The 640-cu-in temperature chamber, designated Model C-106 by Wyle Laboratories Mfg. Div., is designed for either bench or rack mounting. A foam-in-place, fiber-glass insulation, surrounding the specimen chamber, reduces heat transfer for moderate outside skin temperature. **E. W. S.**







Honing Device Improves Tooth Contact

LONDON, ENGLAND–A new honing device improves tooth contact by honing off minute amounts of steel from the tooth flanks where the contact is too hard. This prevents pitting or any other surface fatigue in the teeth caused by misalignment.

Normally applied to the pinions, the honing action is uniform on each tooth around the circumference.

The device consists of an oscillating plastic wheel with the same pitch and other characteristics as the gear to be treated. The wheel is carried by a toothed steel roller in mesh with the pinion. As the gear turns, the machine travels slowly along the axis.

The actual honing is by means of a grinding compound applied to the surface to be treated. The amount of honing necessary is decided by visual inspection of the tooth surfaces, which can be gaged by an expert eye from uniformity of alignment.

Developed by De Laval Ljungstrom Turbine Co. of Sweden, the new method is used to attain a higher degree of perfection in the manufacture of large precision gearing. **R. W. E. M.**

Electronic Measuring System Accurate to 50 Millionths of an Inch

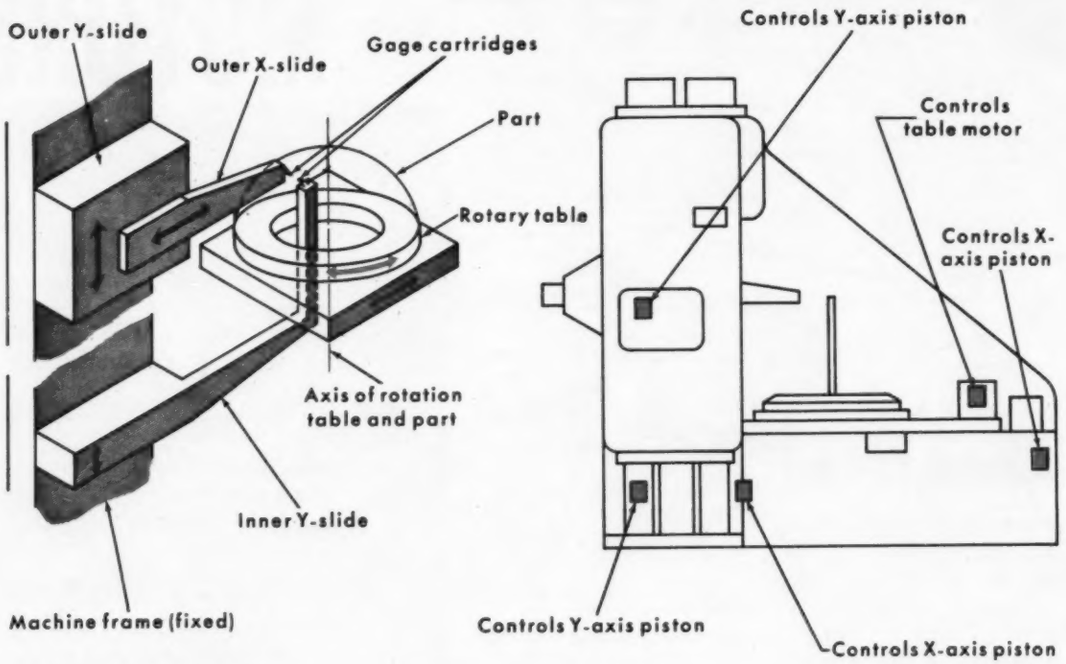
DAYTON, OHIO—Operating from instructions coded on tape, a new universal measuring machine rapidly measures the contours of critical components to a high order of accuracy, and automatically records the results.

The machine combines an electronic measuring system capable of measuring wall thickness to an accuracy of 50 millionths of an inch with an extremely accurate five-axis numerically controlled positioning system. The positioning system operates to position the workpiece and measuring styli to within 15 millionths of an inch of true position with a repeatability of ± 5 millionths of an inch.

Controlled by a Bendix "Dyna-Point"-20 Series Numerical Control Unit operating in conjunction with the independent, electrohydraulic positioning servosystems, the machine is capable of three modes of gaging.

The first, Numerical-Control Scan Gaging, rotates the part slowly under numerical control, continuously scanning the part for dimensional deviation.

MEASURING MACHINE is designed to be operated in controlled environment for greatest accuracy. To minimize effects of deflection and vibration, machine components are mounted on one-piece, eight-ton cast-iron base. Horizontal and vertical slides are of "Meehanite" and travel on antifriction, recirculating bearings. Machine has capacity for inspecting workpieces ranging from 2 to 20 inches in dia and up to 20 inches high.



BASIC MOTIONS OF MACHINE are controlled by individual electrohydraulic servosystems. Inner and outer gaging cartridges contain ball-type electronic transducer sensing elements. This type of stylus permits trimming of an angle with greater accuracy than fixed stylus.

Any deviation exceeding preset limits stops the rotation, prints out the deviation and position, and initiates a point-to-point recorded inspection. When the indicated deviation is again within limits, the scanning is resumed automatically.

The second mode, Numerical Control Increment Gaging, advances the rotary part table preset amounts under tape control, stopping and recording position and deviation at each position. Dimensional deviations within preset limits are printed out in black, those outside the limits in red.

Finally, Operator Control Gaging allows the operator to set up the conditions manually that normally would be included in tape command. This mode of operation also allows a part of unknown dimensions to be explored and the dimensional data printed out in a form which provides a manuscript tape for reproducing the part.

A typical example of the economy possible with this method of measuring is the inspection of a nose cone, involving the verification of 795 measurements including 265 wall-thickness computations. The measuring machine can complete the inspection and provide a printed record of the data in approximately two hours. It is estimated that this same inspection by conventional methods would require 125 hours.

This Universal Five-Axis Numerical Tape-Controlled Measuring Machine was designed and manufactured by the Sheffield Corp., a subsidiary of the Bendix Corp. **E. J. S.**

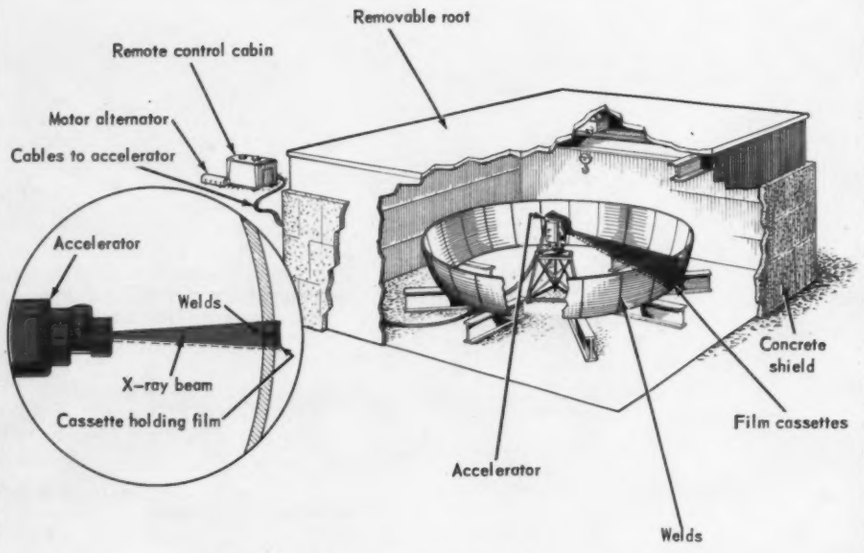
• **MOBILE 4.3-MEGAVOLT LINEAR ACCELERATOR** radiographs welds in thick steel walls of reactor-core pressure vessels on site. Claimed to be the first completely mobile unit, it produces a radiation intensity of over 600 roentgens at a distance of 1 meter from the X-ray source. Focal spot size is less than 2 mm in dia and time required to obtain a radiograph through 4-inch steel, with accelerator 1 meter from the object surface, is as little as 4 sec.

Because of its high intensity output and small focal spot size, the accelerator produces high definition radiographs at considerable distances using relatively short exposures. Thus, it is possible to place the machine in the middle of the pressure vessel. From this position, the vessel can be radiographed with minimum physical movement.

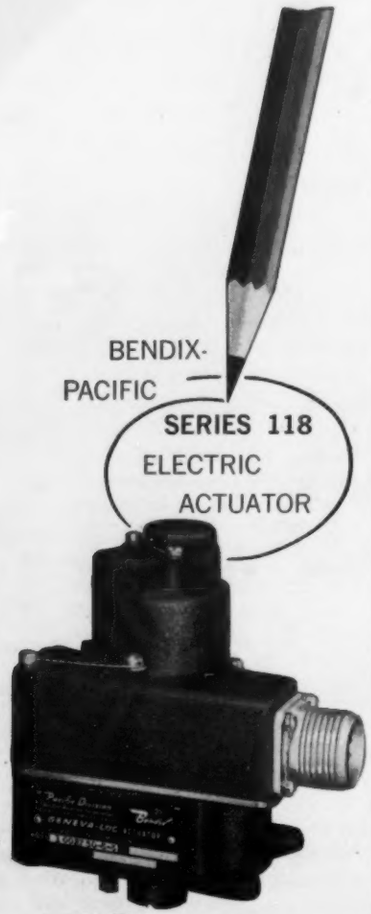
Although the electron beam is accelerated to an energy equivalent to a potential of 4.3 megavolts, only relatively small voltages are required. Acceleration is derived from an electromagnetic field from which the injected electrons extract energy.

MOBILE LINEAR ACCELERATOR weighs 2 tons, measures 8-3/4-ft long by 4-1/2-ft wide by 5-ft high. It is claimed to be superior to cobalt 60 radioisotope sources and conventional X-ray sets currently used for this purpose.

The linear accelerator was designed by Mullard Research Laboratories, London, England. R. W. E. M.



ARTIST'S impression of linear accelerator in use. Individual sections of pressure vessel are prefabricated and transferred to construction site.



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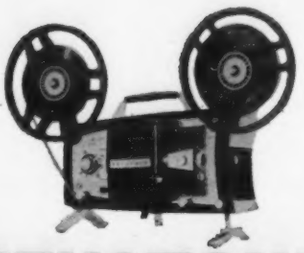

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HEINZE SMF MOTORS

Motors for Keystone Projectors must have reliable high starting torque and variable speeds. Heinze SMF Universal Motors meet these needs precisely. Motors are available in hp ratings from 1/10 to 1/30; load speeds of 5,000 to 7500 rpm; 115 V AC/DC or other voltages in AC or DC. This is just one of a comprehensive line of compact Heinze Universal Motors. They feature high starting and running torque, are versatile to allow all types of mounting arrangements and modifications, are uniform in quality, keyed to high production, and competitively priced.

Write for complete catalog.

HEINZE ELECTRIC COMPANY
685 Lawrence St.
Lowell, Mass.

SUB-FRACTIONAL HORSEPOWER MOTORS AND BLOWERS

Circle 42 on Reader-Service Card

• **SPEED PACER,** to advise motorists how fast or slow they should travel to arrive at the next traffic light while it is still green, has been developed by General Motors Research Laboratories.

Purpose of this prototype installation is to improve traffic flow over suburban and city streets with intersections, as contrasted with limited access roads. The unit is designed to move vehicles in an orderly and uninterrupted run.

A series of illuminated speed-advisory signals hanging over the center of the pavement paces the motorist. These signals are 20-inch-high numerals resembling football or baseball score-board numbers. A motorist entering the four-mile system at either end or from any intersection in between needs only to obey these speed signals which vary from 25 to 45 mph.

Main difference between the "Traffic Pacer" and a conventional progressive traffic control system is that this unit keeps the motorist continuously informed as to how many miles an hour he must go to avoid red signals.

The system is modeled to some extent on a so-called "traffic funnel" now used extensively in Germany to improve both road capacity and traffic safety through elimination of most intersection stops.

The Pacer is designed to increase traffic capacity by as much as 20 percent.

Compact cartridge pumps provide pressure lubrication at minimum cost

by E. H. Schanzlin
Chief Engineer, Tuthill Pump Company

An opportunity for savings exists in many original equipment applications involving pressure lubrication . . . where, in many instances, foresight on the part of the designer will permit the use of a "cartridge" pump which can be built directly into the equipment . . . to provide the greatest possible capacity per cubic inch of pump . . . and ordinarily at a price below those for comparable pumps . . . since every possible extraneous element has been eliminated from their design.

14 Different Units

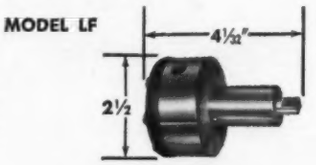
To meet the requirements of these applications Tuthill engineers have developed four different models of cartridge pumps . . . each offered in 3 or 4 sizes for a total of 14 different units . . . for pressures to 200 psi . . . with a capacity range from 56 to 720 gph depending upon pump size and motor speed. These units are all available from stock in any quantity desired. They have been used successfully in many outstanding original equipment applications.

Model LF

Model LF pumps, as shown, have an extremely simple housing and are normally furnished without seals. They are supplied in three sizes with nominal capacities as shown below.

Size	GPH	RPM
00	56	1800
0	105	1800
1	180	1800

(These nominal capacities will also apply to similar sizes of pumps discussed later.)

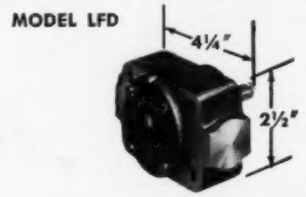


Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 gpm; for pressures to 1500 psi; speeds to 3600 rpm.

Model LF pumps are designed for flange mounting. They offer a choice of internal or external porting. Overall dimensions of these compact units are only 2½" x 4½", and even shorter lengths are possible when pumping conditions permit.

Model LFD

Model LFD cartridge pumps are offered in the same capacity ranges and sizes as model LF. They resemble these basic pumps except that they are provided with a more detailed housing. Model LFD's are designed for flange mounting and normally supplied with either internal porting or ⅜-18 N.P.T. external porting. Shaft seals or ball bearings may also be furnished with these units as an alternate. In the 00, 0, and 1 pump sizes, these units measure 4¼" x 2½" x 3½"

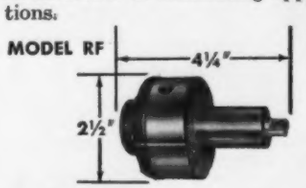


Model LFD pumps are also furnished in pump size 2, with a capacity of 360 gph at 1800 rpm, and 720 gph at 3600 rpm. Overall dimensions are 5⅝" x 3⅞" x 4½".

RF Models

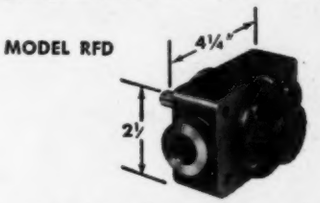
The selection of RF models closely resembles those in the LF range . . . sizes, capacities and general characteristics are identical. However, these units are equipped with Tuthill's special automatic reversing feature which permits driving the pump in either direction without changing the direction of flow . . . with port positions remaining constant . . . without special valving.

The automatic reversing design was developed by Tuthill for applications where the pump must be driven by reversing shafts, or where machinery must be shipped without knowing the ultimate direction of the driving unit. These versatile units have proven their superiority in hundreds of demanding applications.



Model RFD

These units parallel model LFD in capacities, sizes, and general characteristics. Like the model RF above, however, the pumping units have Tuthill's special automatic reversing feature for use with reversing shafts. Dimensions of 00, 0, and 1 sizes are 4¼" x 2⅛" x 3²⁹⁄₃₂". Size 2 pumps measure 5⅝" x 3⅞" x 4¹⁵⁄₃₂".



Wide Variety of Alternates

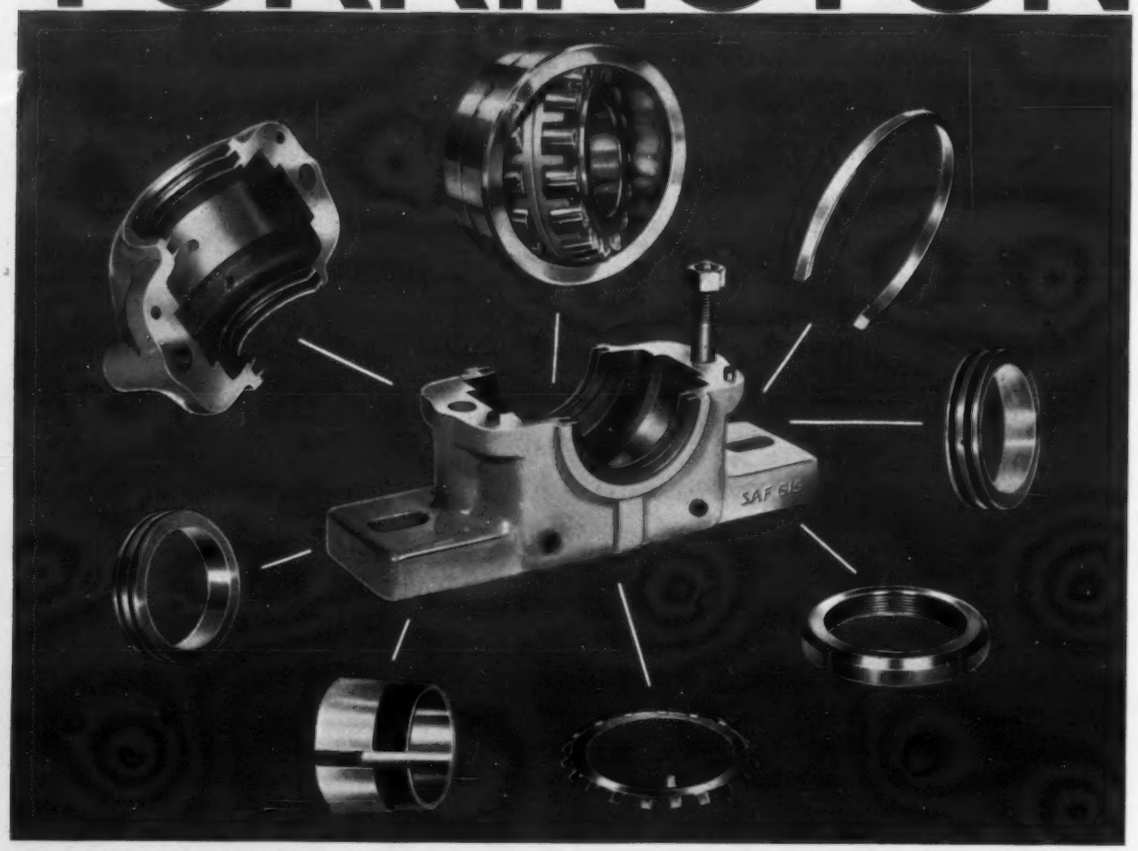
In addition to the basic pump models, various alternates can be provided. For example two alternate shaft modifications are offered for maximum adaptability.

Imaginative use of these cartridge pumps may permit significant savings in your designs. In addition to the economical price, their compactness and light weight can eliminate design headaches. These units offer the maximum amount of lubricating capacity for the minimum amount of pump . . . and often at the minimum expenditure of dollars.

For further details write for catalog section 108. Or, send details on your application so Tuthill can offer suggestions on how these units can be incorporated into your design.

PUMPS FOR YOUR PURPOSE
TUTHILL PUMP COMPANY
943 East 95th Street, Chicago 19, Illinois

TORRINGTON

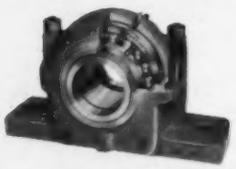


TORRINGTON SPHERICAL ROLLER BEARING PILLOW BLOCKS ...THE INSIDE STORY

All these parts make up a standard series Torrington Spherical Roller Bearing Pillow Block. What you *can't* see in the illustration is the painstaking engineering that goes into each part.

Housing caps and bases, for example, are doweled in pairs throughout manufacture to insure perfect register. The triple labyrinth seals are designed to avoid rubbing contact. A removable stabilizing ring allows "fixed" or "float" operation. The Torrington Self-Aligning Spherical Roller Bearing provides top operating efficiency even under heavy load and misalignment.

Do you have a pillow block problem? It pays to investigate the outstanding performance and long service life of the Torrington Spherical Roller Bearing Pillow Block. Call or write us today.



- ☐ Self-aligning bearing for high radial and thrust capacity
- ☐ Split housing for easy installation and inspection
- ☐ Grease or oil-bath lubrication
- ☐ Standard or heavy duty series available
- ☐ Closed end housing optional
- ☐ "Fixed" or "float" operation

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY South Bend 21, Indiana • Torrington, Connecticut

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INTERNATIONAL SATELLITE SPACE PROBE SUMMARY, as issued by the National Aeronautics and Space Administration, Washington, D. C., reports the following space vehicles in orbit as of July 22, 1961:

Name/Country	Launch Date	Transmitting
Explorer I (US)	1-31-58	No
Vanguard I (US)	3-17-58	Yes
Lunik I (USSR)*	1-2-59	No
Vanguard II (US)	2-17-59	No
Pioneer IV (US)*	3-3-59	No
Explorer VI (US)	8-7-59	No
Vanguard III (US)	9-18-59	No
Explorer VII (US)	10-13-59	Yes
Pioneer V (US)*	3-11-60	No
Tiros I (US)	4-1-60	Yes
Transit I-B (US)	4-13-60	No
Spacecraft I (USSR)	5-15-60	No
Midas II (US)	5-24-60	Yes
Transit II-A (US)	6-22-60	Yes
NRL Satellite (US)	6-22-60	No
Echo I (US)	8-12-60	No
Courier I-B (US)	10-4-60	Yes
Explorer VIII (US)	11-3-60	No
Tiros II (US)	11-23-60	Yes
Samos II (US)	1-31-61	No
Venus Probe (USSR)*	2-12-61	No
Explorer IX (US)	2-16-61	No
Discoverer XX (US)	2-17-61	No
Discoverer XXI (US)	2-18-61	No
Explorer X (US)	3-25-61	No
Discoverer XXIII (US)	4-8-61	No
Explorer XI (US)	4-27-61	Yes
Discoverer XXV (US)	6-16-61	Yes
Transit IV-A (US)	6-29-61	Yes
Injun-SR-3 (US)	6-29-61	Yes
Discoverer XXVI (US)	7-7-61	No
Tiros III (US)	7-12-61	Yes
Midas III (US)	7-12-61	Not Available

*In solar orbit; others in earth orbit.

Current Summary (7-22-61)		Complete Summary (Launched to date)	
Earth Orbit:	US –27 USSR–1	Earth Orbit	US –45 USSR–12*
Solar Orbit:	US –2 USSR–2	Solar Orbit:	US –2 USSR–2
Transmitting:	US –11 USSR–0	Lunar Impact:	US –0 USSR–1

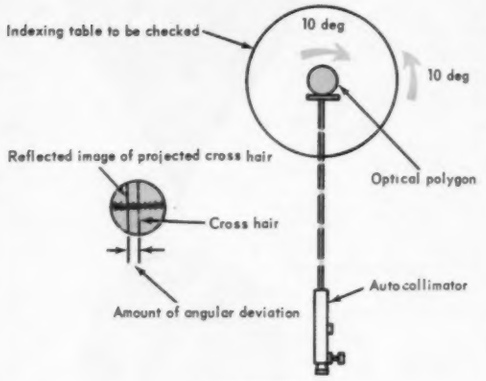
*Lunik III passed once around the moon, then into earth orbit.

SIMULATED POLYGON is made by mounting front-surface mirror on index table. Accurately ground, matching serrations between tables provide degree by degree indexing with accuracy within 1/4 sec of arc, equivalent to thickness of sheet of paper at 100-ft radius. Builtin magnifying glass facilitates setting.

• **FRONT-SURFACE MIRROR** mounted parallel to the axis of rotation on the side of an index table can be used as a multiface polygon mirror optical tool. The index table is of the matching-serration-type. The 360 matching serrations provide single-degree indexing. The instrument can be used with an autocollimator for checking tools or for layout to degree increments wherever optical tooling may be applied.

The simulated optical polygon is a product development of the Michigan Tool Co., Detroit, Mich.

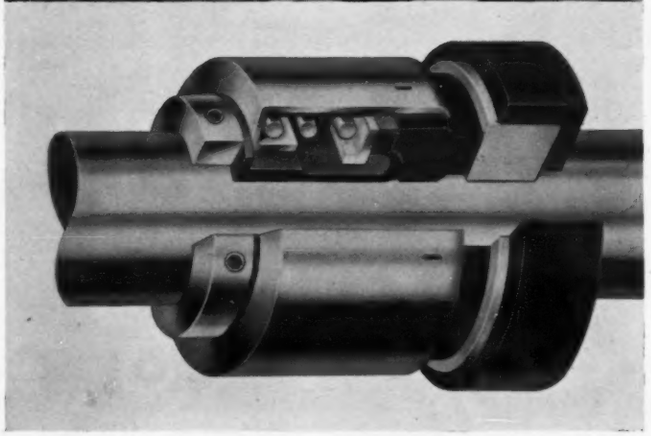
E. J. S.



PROCEDURE

1. Orient polygon so that reflected image of cross hair coincides with cross hair in collimator.
2. Rotate polygon 10 degrees in one direction and indexing table 10 degrees in opposite direction.
3. Read deviation directly on collimator cross-hair scale.

OPTICAL POLYGON AND COLLIMATOR may be used to check indexing equipment. Polygon is mounted on unit to be tested with axis of rotation concentric. Autocollimator is set up to receive reflection from polygon mirror. If tool checked does not agree with polygon, error may be read on scale on autocollimator.



MECHANICAL SEALS in Design Engineering

Here's a sure way to maintain tight sealing under severe conditions—design with Garlock PK Mechanical Seals. Over the years, user after user has expressed complete confidence in Garlock PK MECHANIPAK Mechanical Seals. One such example is the Construction Machinery Company, a leading producer of contractor and irrigation pumps. They had a problem of maintaining an air-tight seal along the shaft of end suction and self-priming centrifugal pumps to keep the suction lift operating at maximum efficiency.

To do the job properly, Garlock PK MECHANIPAK seals were specified. Since the original installation nearly 10 years ago, the seals have done the job well at pressures to 150 p.s.i., on shafts with speeds to 3500 r.p.m., and where muddy, silt-laden water churns violently without letup. Long life, less downtime, and greater convenience are just a few of the benefits realized; Construction Machinery is particularly pleased with the easy to install, self-contained "package" construction of Garlock PK MECHANIPAK Seals.

Pass this fine performance on to your customers. Design to include Garlock PK Mechanical Seals on centrifugal pumps, automatic washers, dishwashers, gear boxes, speed reducers. The seals will perform effectively at temperatures to 212°F, pressures to 150 p.s.i., shaft speeds to 2000 f.p.m. Your local Garlock representative has complete information. Call him at the nearest of the 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-150. Garlock Inc., Palmyra, N.Y.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the complete line of quality Garlock products... Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Garlock PK MECHANIPAK* Seals keep dirty water from motor, help maintain long suction lift by preventing air leakage on Construction Machinery Company pumps (top).

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GARLOCK

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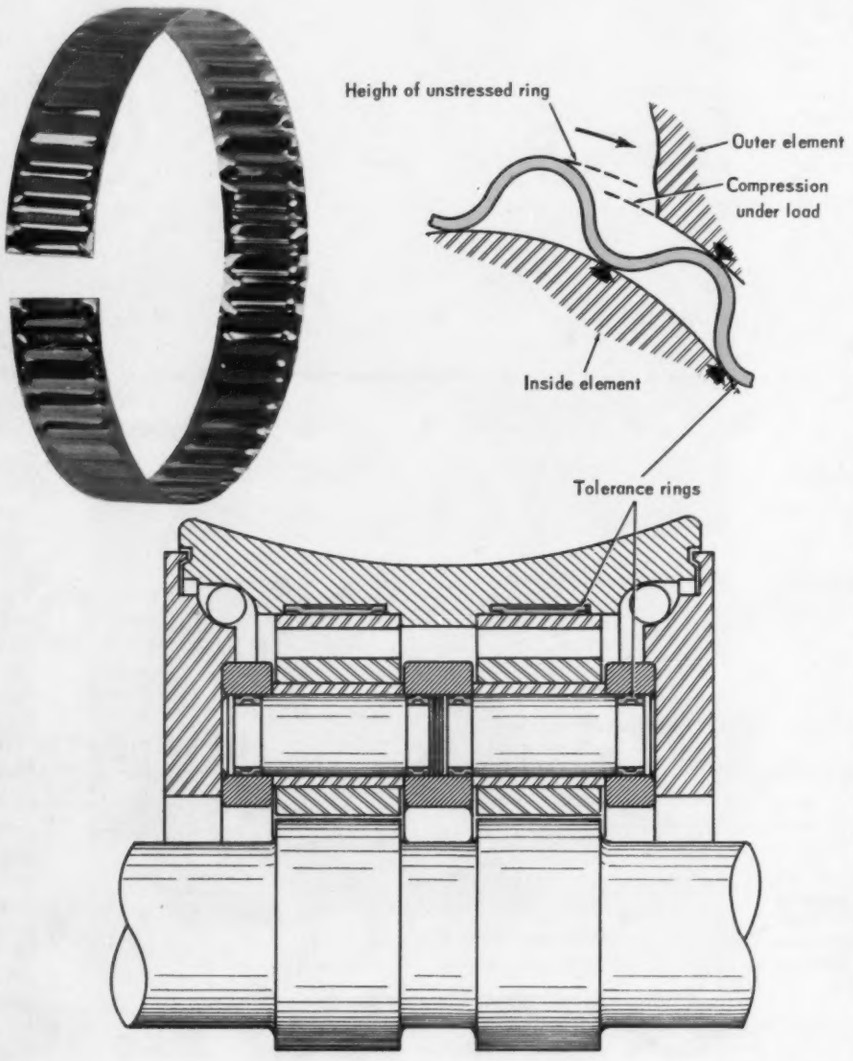
IDEAS IN THE NEWS

• **TOLERANCE RINGS** serve as overload clutch in the windlass drive of a wrecking truck. Shaped with an elastically deformable sinusoidal cross-section in the radial plane, the rings are compressed during assembly and connect concentric inner and outer surfaces by friction. If crane loads are excessive or blocked, tolerance rings begin to slip, preventing cable failure and damage.

The cable windlass is designed as a planetary gear transmission. On each carrier, four smaller tolerance rings are used in shaft recesses to hold planetary gears in place for easy assembly. This eliminates keys. Ring gears are locked to windlass runner by two 50- by 380-mm-dia tolerance rings, which together transmit a 19,000 ft-lb service torque. Load limit is 20 tons; as load reaches 25-27 tons, rings begin to slip.

Tolerance rings are a product of Deutsche Star Kugelhalter GmbH; US licensee is Roller Bearing Co. of America, West Trenton, N. J. Wrecking crane was designed by Kloeckner-Humboldt-Deutz AG, Ulm, Germany.

R. F. S.



the question is time

the answer is money

Time has brought decisive progress in the fight against cancer. Ten years ago one in four persons with cancer was saved. Today it's one in three. But time alone will not conquer cancer. Time plus research will. And research needs your dollars. Send your contribution today to "Cancer," c/o your local post office.

AMERICAN CANCER SOCIETY

• **DYNAMIC WEIGHT SHIFT** of fuel in B-52H during rapid aircraft acceleration is being studied at The Boeing Co.'s Wichita, Kan., Div., home of the global ballistic missile bomber. Increased thrust of the "H's" turbofan engines created a number of different handling characteristics because of the rapid movement of fuel toward the rear of the tanks.

Scale models of the B-52H fuel cells mounted on a giant pendulum show engineers how swiftly, and in what directions, the fuel moves when subjected to sudden linear acceleration. The pendulum, designed specifically for this test by Boeing engineers, can swing as high as 30 deg and the resulting force generated when it is stopped at that maximum height is equivalent to about 1/2G linear acceleration.

The new techniques being developed through the tests will be included in B-52 improvement studies and on initial designs of new and more advanced aircraft.

Meetings

Ann Arbor, Mich. **Oct. 3-6**	SEVENTH ANNUAL U.S. ARMY HUMAN FACTORS ENGINEERING CONFERENCE, Army Research Office, Office of the Chief of Research and Development, Institute of Science and Technology, University of Michigan.
Santa Catalina Island, Calif. **Oct. 5-8**	ANNUAL MEETING, American Society of Industrial Designers, St. Catherine Hotel.
Chicago, Ill. **Oct. 9-11**	NATIONAL ELECTRONICS CONFERENCE, Institute of Radio Engineers, American Institute of Electrical Engineers, et al, International Amphitheatre.
Los Angeles, Calif. **Oct. 9-13**	NATIONAL AERONAUTIC MEETING, Society of Automotive Engineers, The Ambassador Hotel.
New York, N. Y. **Oct. 9-15**	SPACE FLIGHT REPORT TO THE NATION AND 16TH ANNUAL MEETING, American Rocket Society, New York Coliseum.
Washington, D. C. **Oct. 16-19**	EIGHTH ANNUAL SYMPOSIUM, American Vacuum Society Inc.
Chicago, Ill. **Oct. 17-19**	JOINT LUBRICATION CONFERENCE, American Society of Lubrication Engineers and American Society of Mechanical Engineers, Morrison Hotel.
Detroit, Mich. **Oct. 23-27**	NATIONAL METAL CONGRESS AND EXPOSITION, American Society for Metals, Cobo Hall.

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The Alkon Series A 4-way valve line sets new high standards of service and reliability. Carbide-hard working and sealing surfaces end troublesome seal swelling and scoring, insuring long life with low maintenance.

NEW **Even greater circuit flexibility is built into the new Alkon pilot-operated solenoid valve — and a complete ⅜" line has been added to the 50-million-cycle reliability of the proven ¼" line. All actuators are available — direct solenoid, pilot solenoid, pilot, bleeder, hand, foot, palm button. Now ⅜" as well as ¼" sub-plate mounting is standard.**

LOWEST PRICES **and high value are the hallmarks of all Alkon products — valves, cylinders and drill units. Check these prices!**

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NEW pilot operated double solenoid valve . . . $44.75

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INDEX OF ADVERTISERS

A & A Mfg. Co. Inc. 13
Alkon Products Corp. 57
Allied Radio Corp. 59
American Hardware-Corbin Cabinet Lock 12
Anchor Coupling Co., Inc. 35

Barksdale Valves Co., Control Valve Div. 10
Bendix Corp., Bendix Products Div. 25
Pacific Div. 52

Carr Lane Mfg. Co. 41
Cherry Electrical Products Corp. 11
Chicago Rawhide Mfg. Co. ..... Back cover
Chiksan Co., Subsidiary of Food Machine & Chemical Corp. 37
Commercial Cam & Machine Co. 36
Cutler-Hammer, Inc. 58

Davies, Harry, Molding Co. 59
Dings Brakes, Inc. 60
du Pont, E. I. de Nemours & Co.,
Elastomer Chemicals Dept. ("Adiprene") 6
Photo Products Dept. ("Cronaflex") 16

E-T-A Products Co. of America 37

Fairchild Engine & Airplane Corp., Stratos Div. 26
Federal-Mogul-Bower Bearings, Inc., Federal-Mogul Div. 17

Garlock, Inc. 55
General American Transportation Corp., Kanigen Div. 18
General Controls Co. ..... Inside back cover
General Electric Co., Silicone Products Dept. 29
General Gas Light Co., Humphrey Products Div. 28
General Motors Corp., New Departure Div. ..... Inside front cover

Goodrich, B. F. Co., Aviation Products Div. 58
Greene Tweed & Co 56
Gries Reproducer Corp. 38

Heinze Electric Co. 52
Houdaille Industries, Inc., Buffalo Hydraulics Div. 40

Johnson Corp. 38

Kaiser Aluminum & Chemical Corp. 42-43

Maas & Waldstein Co. 21
Marvel Engineering Co. 26
Minnesota Rubber Co. 1

Parker-Hannifin Corp., Hannifin Co. Div. 27
Perfecting Service Co. 58
Perkins Machine & Gear Co. 34
Post, Frederick, Co. 2
Pure Carbon Co., Inc. 19

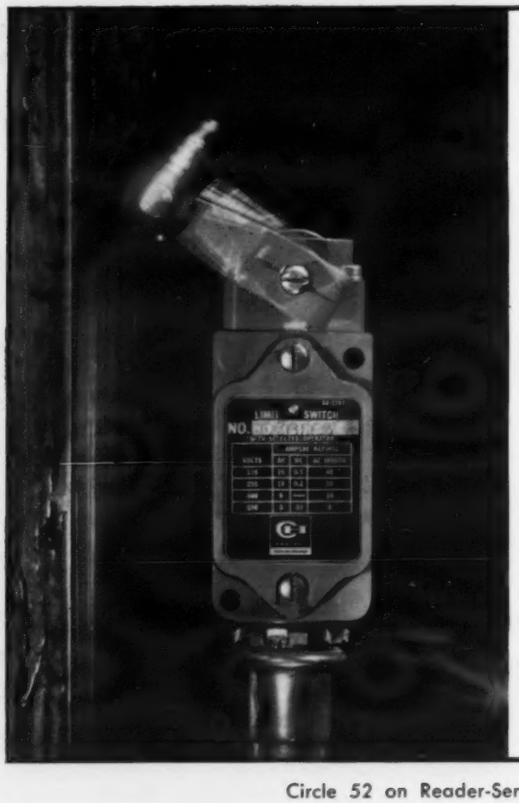
Ramsey Corp. 41

South Chester Corp., Southco Div. 23
Southwest Products Co. 45
Speer Carbon Co. 24
Standard Pressed Steel Co., Industrial Fastener Div. 7, 35
Syncro Corp. 59
Syntron Co. 39

Tomkins-Johnson Co. 9
Torrington Co. 54
Tuthill Pump Co. 53

United-Carr Fastener Corp., Carr Fastener Co., Div. 33
United Electric Controls Co. 15
United States Steel Corp., American Steel & Wire Div. 30-31

White, S. S. Dental Mfg. Co., Plastics Div. 3
Wilkerson Corp. 45



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The serious problem of limit switch failures has now been greatly reduced thanks to Cutler-Hammer's new oiltight limit switch. Under test conditions much tougher than in actual production, our limit switches have lasted far longer than any other brand.

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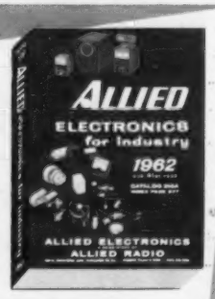

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INDEX OF NEW PRODUCTS AND LITERATURE

NEW PRODUCTS

MECHANICAL

Brakes and clutches, miniature hp 307
Dials and verniers, precision 306
Drives, miniaturized slow-speed 304
Fittings, fluid-line swivel 301
Motors, d-c display 305
Servoactuators, clutch-type 303
Timers, sequence 302

ELECTRICAL

Lamps, subminiature 309
Resistors, light dependent 308
Thermocouples, miniature vacuum 310
Transistor radiators, double-ended 311

MATERIALS

Coatings, aluminum enamel 312
Lubricants, dry 316
Plastics, nylon-based reinforced 315
Resins, thermoplastic 317
Solders, multi-alloy 314
Wafers, diode 313

EQUIPMENT

Liquid epoxy dispensers 319
Stamp kits, graph rubber 318
Transceivers, pocket-sized 320

NEW LITERATURE

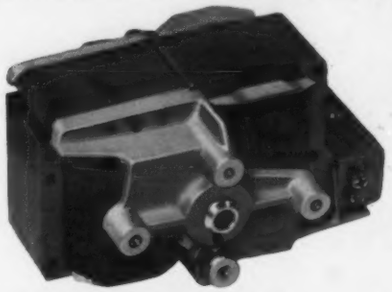
MECHANICAL

Fasteners, specialty 453
Pumps, Cylinders, and Valves 456

DESIGN AIDS

Broadcasting, stereo/FM 455
Cooling, semiconductor 451
Documents, current history 454
Slide rule, vacuum pump 452

WHERE CAN YOU USE THIS VIBRATORY MOTOR?



Delivers 14,400 strokes per minute with amplitude up to ¼". Rated at four amps full load at 115 vac, VM-40 is the largest of three, standard Syncro motors widely used in reciprocating sanders and jigsaws. Overall dimensions are 2½ x 3½ x 4½. Armature has a multiple torsion bar pivot bearing with no wear surfaces. A 16-billion cycle life test shows no appreciable wear. Excellent for continuous duty feeders, sorters, mixers, separators, packagers. Why not try VM-40 on your pet project? Bulletin available.

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Graphic Journalism . . .

Illustrating

DESIGN DESIGN IDEAS NEWS

LETS **DINGS** DO IT

For versatile Moduline® Motocylinders: Westinghouse *relies on* DINGS MAGNETIC DISC BRAKES for fast, frequent stops

The cyclical operation of Moduline® Motocylinders, with as many as 30 thrust and return strokes per minute, demands not only instantaneous braking action but brakes with long, trouble-free service life.

That's why Westinghouse uses Dings Direct-Acting Magnetic Disc Brakes. The Dings Brakes used on Moduline® Motocylinders are estimated to be good for 200,000 to one million stops (depending on application) before adjustment is necessary.

In addition to positive, instantaneous stops and low maintenance requirements, these other Dings Brake advantages will add efficiency to your operations:

- No mechanical linkages to require maintenance. Easily accessible and simple to install—brakes mount on standard NEMA "C" frames. Available for horizontal, vertical or foot mounting. Easily accommodates thru shaft in all standard waterproof and dust-tight enclosures. Wide torque range—1½ to 175 lbs. ft.—easy torque adjustment.
- Fail-safe design in event of power failure. • Standard drip-proof, waterproof or dust-tight enclosures. • Hazardous location brakes UL approved.

To help solve your specific brake problems, call on Dings complete engineering service.

Write for Bulletin BK4006

DINGS BRAKES, INC.
A SUBSIDIARY OF DINGS MAGNETIC SEPARATOR CO.
4715 West Electric Avenue
Milwaukee 46, Wisconsin

DB-261

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PLANS AND CROSS-SECTIONS

Kitchen Rocketry

If a "do-it-yourself" enthusiast ever decided to start in the rocket business, the best place he could start would be right at home—in the kitchen.

The average housewife makes daily use of many household products which are simultaneously hard at work in the space industries and laboratories, such as those of Aerojet General Corp. who made the following kitchen survey.

The vinegar and salt the housewife uses to season her pickled beets, for example, are used in certain processes of making rocket fuels. And so is the bicarbonate of soda her husband takes after eating her pickled beets.

The cleaner compound used to open clogged drain pipes commonly is used to purify rocket fuels. And the laundry bleach she uses to make clothes sunshine bright is actually sodium hypochlorite, an ingredient of a rocket engine fuel intended to bring man closer to that sunshine.

Another rocket fuel ingredient is ethylene glycol—known as antifreeze around the garage. And another fuel—right from the medicine cabinet: peroxide. Cigarette lighter fluid and spot remover fluid are a couple of other handy household items at work, these two being used in chemical analyses.

And if it begins to sound like the scientists are using just about everything but the kitchen sink—don't count that out either. The garbage disposer is almost identical to the device used to grind up certain solid rocket propellant ingredients.

Cloudellites'

The earth has two natural, cloud-like satellites which travel in nearly circular paths at the same distance as the moon.

The two cloud-like satellites, believed to be a swarm of tiny particles, or meteors, can be seen as faintly luminous patches with the unaided eye under exceptionally favorable circumstances.

The objects were found by Dr. K. Kordylewski of Krakow Observatory, Poland, who started searching for them telescopically ten years ago. Although the clouds travel in the same path as the moon, they are about 60 deg behind it. A special combination of circumstances is needed to make the clouds observable.

Dr. Kordylewski's efforts to photograph the earth's cloud-like satellites were unsuccessful until this spring, when he recorded them on March 6 and April 6 using an f/1.5 camera of 50-mm focus, after taking special precautions.

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6	7	8	9	10	156	157	158	159	160
11	12	13	14	15	161	162	163	164	165
16	17	18	19	20	166	167	168	169	170
21	22	23	24	25	171	172	173	174	175
26	27	28	29	30	176	177	178	179	180
31	32	33	34	35	181	182	183	184	185
36	37	38	39	40	186	187	188	189	190
41	42	43	44	45	191	192	193	194	195
46	47	48	49	50	196	197	198	199	200
51	52	53	54	55	201	202	203	204	205
56	57	58	59	60	206	207	208	209	210
61	62	63	64	65	211	212	213	214	215
66	67	68	69	70	216	217	218	219	220
71	72	73	74	75	221	222	223	224	225
76	77	78	79	80	226	227	228	229	230
81	82	83	84	85	231	232	233	234	235
86	87	88	89	90	236	237	238	239	240
91	92	93	94	95	241	242	243	244	245
96	97	98	99	100	246	247	248	249	250
101	102	103	104	105	251	252	253	254	255
106	107	108	109	110	256	157	258	259	260
111	112	113	114	115	261	262	263	264	265
116	117	118	119	120	266	267	268	269	270
121	122	123	124	125	271	272	273	274	275
126	127	128	129	130	276	277	278	279	280
131	132	133	134	135	281	282	283	284	285
136	137	138	139	140	286	287	288	289	290
141	142	143	144	145	291	292	293	294	235
146	147	148	149	150	296	297	298	299	300

NEW PRODUCTS

301	302	303	304	305
306	307	308	309	310
311	312	313	314	315
316	317	318	319	320
321	322	323	324	325
326	327	328	329	330
331	332	333	334	335
336	337	338	339	340
341	342	343	344	345
346	347	348	349	350
351	352	353	354	355
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391	392	393	394	395
396	397	398	399	400
401	402	403	404	405
406	407	408	409	410
411	412	413	414	415
416	417	418	419	420
421	422	423	424	425
426	427	428	429	430
431	432	433	434	435
436	437	438	439	440
441	442	443	444	445
446	447	448	449	450

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451	452	453	454	455
456	457	458	459	460
461	462	463	464	465
466	467	468	469	470
471	472	473	474	475
476	477	478	479	480
481	482	483	484	485
486	487	488	489	490
491	492	493	494	495
496	497	498	499	500
501	502	503	504	505
506	507	508	509	510
511	512	513	514	515
516	517	518	519	520
521	522	523	524	525

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526	527	528	529	530
531	532	533	534	535
536	537	538	539	540
541	542	543	544	545

OTHERS

546	547	548	549	550
551	552	553	554	555
556	557	558	559	560
561	562	563	564	565

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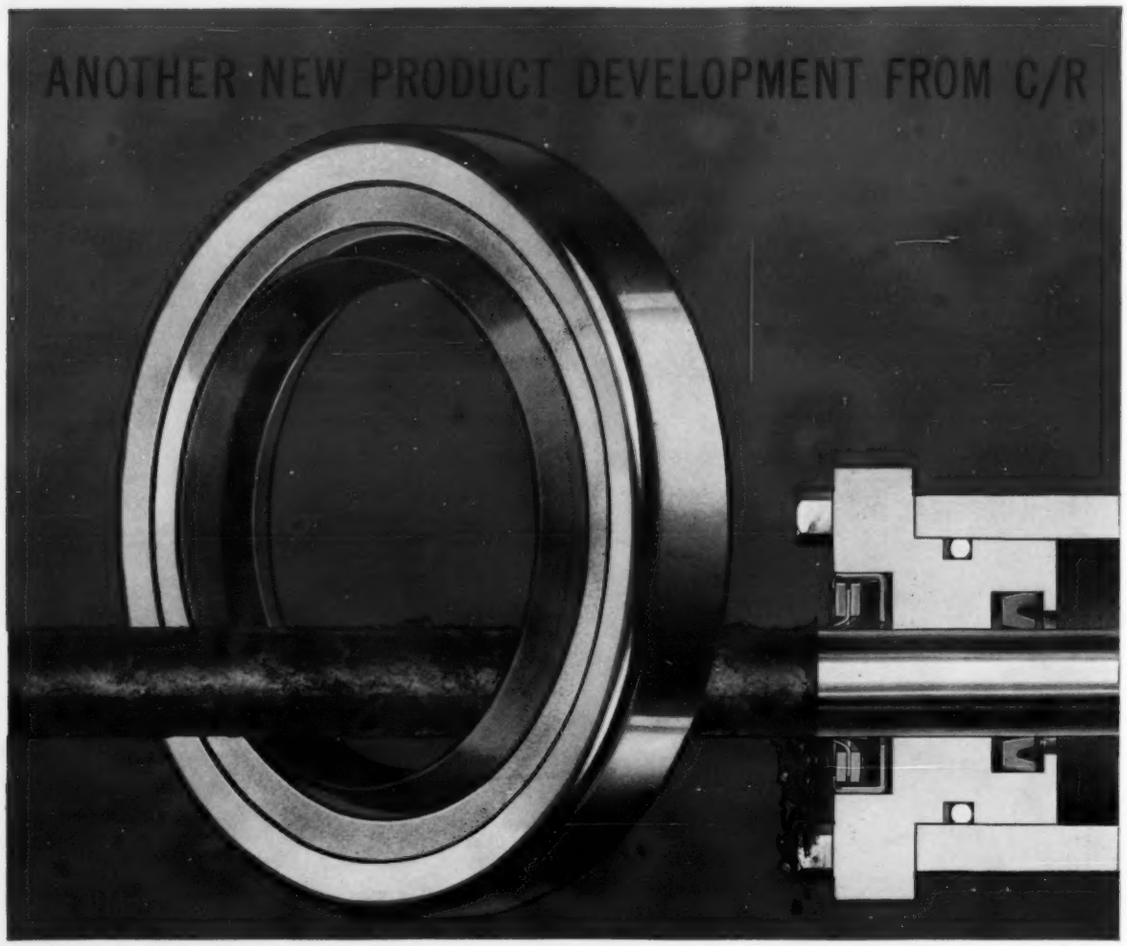

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